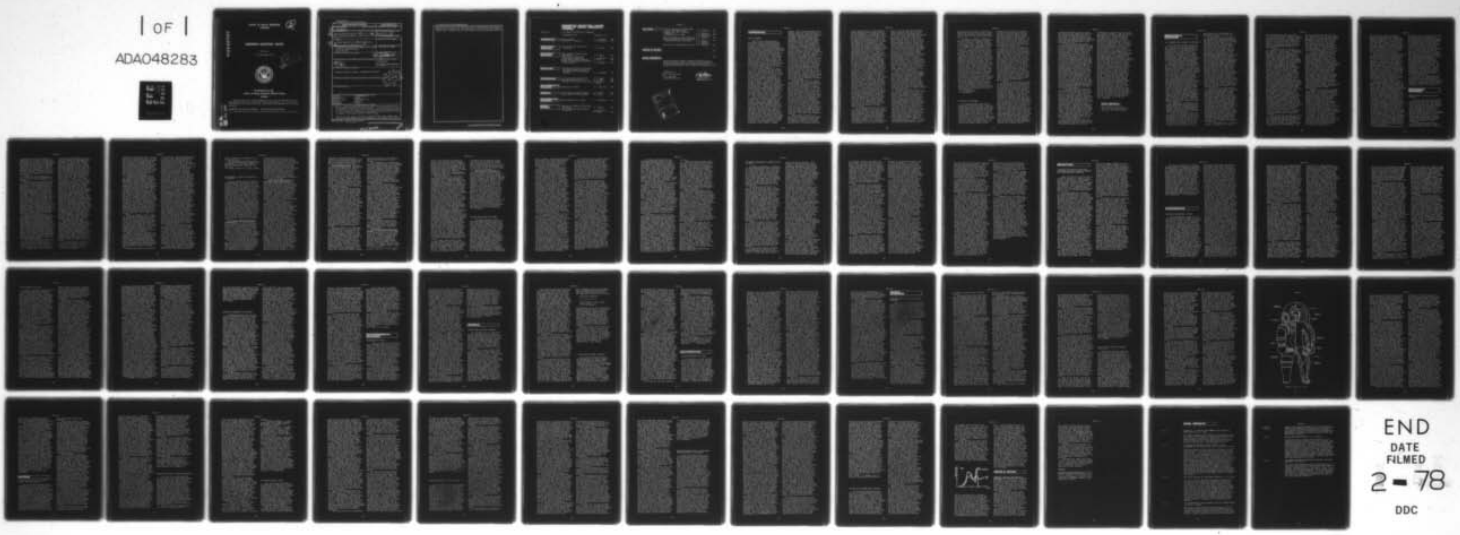
AD-A048 283 OFFICE OF NAVAL RESEARCH LONDON (ENGLAND) F/G 5/2
EUROPEAN SCIENTIFIC NOTES. VOLUME 30, NUMBER 9,(U)
SEP 76 J W MILLER, V S HEWITSON
UNCLASSIFIED ESN-30-9 NL

| OF |
ADA048283



END
DATE FILMED
2-78
DDC

AD A048283

OFFICE OF NAVAL RESEARCH
LONDON

(2)

EUROPEAN SCIENTIFIC NOTES

ESN-30-9

30 SEPTEMBER 1976

DDC
JAN 11 1978
F

Distributed by the
Office of Naval Research Branch Office,
London

This document is issued primarily for the information of U.S. Government scientific personnel and contractors. It is not considered part of the scientific literature and should not be cited as such.

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

AD No.
DDC FILE COPY

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: ESN-30-9 (14) ✓	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)*: EUROPEAN SCIENTIFIC NOTES. Volume 30, (6)	5. TYPE OF REPORT & PERIOD COVERED: Number 9,
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): J.W. Miller and Victoria S. Hewitson editors (10)	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US OFFICE OF NAVAL RESEARCH BRANCH OFFICE LONDON, 223/231 Old Marylebone Road, London NW1 5TH ✓	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS (11)	12. REPORT DATE: 30 September 1976
	13. NUMBER OF PAGES: 48
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*: (12) 53p.	15. SECURITY CLASS. *(of this report)*: UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

DDC RECEIVED JAN 11 1978 F

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

AEROSPACE	ENVIRONMENTAL SCI
BEHAVIOURAL SCI	GENERAL
BIOLOGICAL SCI	MATHEMATICAL SCI
EDUCATION	OCEAN SCI
ENGINEERING	PHYSICS

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This is a monthly publication presenting brief articles concerning recent developments in European Scientific Research. It is hoped that these articles (which do not constitute part of the scientific literature) may prove of value to American scientists by disclosing interesting information well in advance of the usual scientific publications.

The articles are written primarily by members of the staff of ONRL, with certain articles prepared by, or in cooperation with, members of the sci-

265000

entific staffs of the United States Air Force's European Office of Aerospace Research and Development and the United States Army's Research and Standardization Group. Articles are also contributed by visiting Stateside scientists

EUROPEAN SCIENTIFIC NOTES
OFFICE OF NAVAL RESEARCH
LONDON

Edited by J. W. Miller and Victoria S. Hewitson

30 September 1976 Volume 30, No. 9

AEROSPACE

Space in Europe — L. H. Meredith — 385
Ultraviolet to Infrared — L. H. Meredith — 387

BEHAVIORAL SCIENCES

21st International Congress of Psychology — J. W. Miller — 389

BIOLOGICAL SCIENCES

Human Leukocyte Antigens (HLA) and Disease — J. N. Woody — 391
Hydrocarbons, Enzymes and Cybernetics--A Mixed Bag — J. B. Bateman — 394
Polymer Chemists Meet in Prague — M. Blank — 396
The Marine Contamination Laboratory Near La Spezia — J. B. Bateman — 399

EDUCATION

A Foreign-Aid Initiative From Spain: New Higher Education Scheme For Students From Lesser-Developed Countries — J. H. Schulman — 402

ENGINEERING

Electrical Engineering in Egypt — D. K. Cheng — 403
Fluid Dynamics at Poitiers — R. H. Nunn — 406
Tribology--Technology or Tautology? — R. H. Nunn & H. Herman — 408

ENVIRONMENTAL SCIENCES

Meteorology in Athens — A. I. Barcilon — 409

GENERAL

Arabian Names and Arabic Numerals — D. K. Cheng — 410
A Visit With Sir James Lighthill — M. Lessen — 411

MATHEMATICAL SCIENCES

Applied Mathematics At Leeds — A. I. Barcilon — 412

OCEAN SCIENCE

Conference on Behavior of Off-Shore Structures — J. P. Walsh — 414
JIM, A Jointly Developed Armored Diving Suit — J. W. Miller & H. Herman — 416

PHYSICS

A New Possibility For a Blue-Green Laser: The CdHg Excimer	L. G. DeShazer	420
European Who's Who In Quantum Electronics	L. G. DeShazer	421
High Power Lasers At AWRE	L. G. DeShazer & J. H. Gorrell, Jr.	422
Nuclear Orientation Study Conference	T. A. Kitchens	424
Short Wavelength Lasers At Amsterdam's Quantum Electronics Conference	R. C. Elton, L. J. Palumbo & J. F. Reintjes	426
The Physics of Normal Metal Contacts	T. A. Kitchens	428

NEWS & NOTES

429

ONRL REPORTS

431

European Scientific Notes is Group II Newsletter type Class B periodical prepared and distributed by the Office of Naval Research London in accordance with NAVEXOS-P-35 prepared and submitted by the scientific and technical staff.

J B Bateman
Acting Chief Scientist
J. H. SCHULMAN
Scientific Director

L. Roy Patterson
L. ROY PATTERSON
Captain, USN
Commanding Officer

AEROSPACE

SPACE IN EUROPE

Over the past year there have been about 30 ESN articles reporting on various aspects of European space research. Included were overviews of the programs of some of the research groups as well as the progress individuals have reported at conferences and meetings. It was the intention for each of the notes to provide significant information on specific subjects, and readers are referred to these notes if such details are their prime interest. While these notes in total also serve to give some flavor of the total European space research program, it is the intention of this article to present in a more concise and complete manner some observations on the total program and on the ways in which it has been changing.

First of all, it should be recognized that the program in each European country is different from that in the others in terms of the type of work that is in process as well as in terms of its administrative support structure. As a result, the general observations in this article apply in varying degrees to each country. It cannot be stressed enough to those in the US that Europe is not an entity composed of countries differing only as much as New York, Texas, and California. Instead the languages, traditions and governmental structures and priorities differ markedly from country to country. This is true even in the space research area where the European Space Agency (ESA) is providing a focus for such activities in Europe.

While ESA itself is reasonably new, having been established in 1975, it is in large part a restructuring and combining of the earlier European Space Research Organization (ESRO) and the European Launcher Development Organization (ELDO). These organizations were formed in 1964 and were responsible for launching seven satellites. This was less than a quarter of the number of satellites launched in European national programs in the same period. However, the importance of the ESA program relative to the space programs of individual European countries will undoubtedly markedly increase. This is due to a number of factors, the most important probably being that the ESA member countries (Belgium, France, Denmark, Germany, Ireland, Italy, The Netherlands, Spain, Sweden, Switzerland and the United Kingdom) each have committed themselves to support ESA each year with an essentially fixed buying-power amount of funds. These are international commitments of the individual governments and are not subject to short-period fluctuations in governmental policies. Instead the mandatory contribution by each member country is determined by the country's gross national product. These funds are used for the scientific satellite program and general operations but, in addition, member countries can fund "special projects" (i.e., Spacelab, application satellites, and launch vehicles) at levels commensurate with their level of interest. The net result of this stable yet flexible approach has been that the ESA program has been able to proceed on a relatively even basis. At the same time, however, inflation and shifting governmental priorities coupled with the substantial contributions to ESA have resulted in the phasing back of most strictly national space programs. As one example, it is unlikely that Germany will continue their national satellite program which in the past was responsible for the Azur, Wika, Aeros, Symphonie and Helios satellite programs.

Another factor which is tending to strengthen ESA is the continuing shift in space science from the flight of individual experiments on small satellites to the flight of complete observing facilities that can be used for a variety of studies (i.e., the US Space Telescope and the laser atmospheric sounding facility described in ESN 30-7:338). In many cases these larger facilities are beyond the capability of an individual European country either fiscally or technically. They can, however, be implemented by ESA since it provides a mechanism to combine the resources of many countries. It is likely that the availability of the US space shuttle will accelerate this shift toward facilities since it can carry instruments about ten times larger than those now being flown into space and return them to earth for refurbishment and subsequent reflight.

The national programs in the future will largely be directed toward the flights of sounding rockets and balloons, as opposed to the flights of satellites, and the provision of experiments for satellites, balloons,

and the space shuttle. Within these national programs, balloons will receive increased emphasis. In addition to their use in earth observation programs, they will be employed in a wide range of astrophysical investigations. In fact, it is expected that essentially all of the astrophysical research programs on sounding rockets will be phased out. They will initially be replaced by balloon experiments and later by a combination of balloon and shuttle experiments. This will leave the scientific sounding-rocket program mainly oriented toward auroral and magnetospheric studies. Even in these areas, however, it is likely that the program will also be phased back. There is only one area in which increased sounding-rocket efforts are likely. This is in materials research that uses the "zero g" capability that sounding rockets can provide to conduct studies in areas such as crystal growth, composite materials, fluid physics, and the properties of pure metals. As described in ESN 30-8:347, a substantial effort in this area will probably be initiated by Germany. Even this, however, will probably be a transient program increase which will last only until the space shuttle will be available for such experiments, in about 1980. In fact, it was the future availability of the shuttle which was largely responsible for the generation of this materials sounding-rocket program. This is just one facet of what will almost certainly be an increasing effort in Europe to get experiments ready for flight on the space shuttle. It will partly be due to the attractive technical capabilities of the shuttle, but it will also be forced by the major effort Europe is currently expending in developing the Spacelab for flight in the shuttle and the implied subsequent need then to use the Spacelab and shuttle. The Spacelab itself will fly in the shuttle's cargo bay and will be required for support services by all experiments, both European and US, that are to operate in space using the shuttle as a base (ESN 30-8:349).

The sounding-rocket/shuttle program is just one example of the very close relationship between the US and European space programs. This coupling exists even though Europe has the technical capability of implementing essentially all aspects of space missions except satellite launches, and a launcher development program is now in process. The reasons for this close relationship are multiple, but one of the primary ones is that the constrained European fiscal resources mean it is very unlikely that they will embark upon a space program that duplicates one planned by the US. Thus, their planning of which new projects to start vitally depends on the content of the US program. Another reason is that with the increased sophistication of space missions even ESA cannot do some of the larger projects by itself without putting its entire program out of balance. As a result ESA must conduct such projects jointly with the US or some other country. The two new ESA projects which seem to have the best chance of approval, an instrument for the US Space Telescope Project and one of the two spacecraft for an out-of-the-ecliptic plane mission, are both of this cooperative type. A final reason for the coupling is that technical capabilities exist in the US program that European researchers need to use to stay in the forefront of their research areas. Thus, many of the research groups depend on US satellites as the carriers of their experiments.

Such factors combine to make essentially all levels of people engaged in space work in Europe very dependent on an accurate knowledge of the plans and directions of the US space program. This dependence coupled with their physical separation from the US and the different timing of their project approval process has created a situation in which minor perturbations, or even rumors of these in the US program, have caused misunderstandings and over-reactions.

As to the technical content of the European space program, it is clear that in many countries the space capabilities developed to support scientific experiments are finding increasing use in a variety of applied areas. These range from using the space-instrumentation technology for ground-based applications, to developing ground systems to interface with space systems (such as data buoys, receiving stations and earth observation data analysis facilities) to designing new space systems to exploit the use of space. These applied systems cover a broad spectrum and include the materials work already mentioned, meteorological satellites, and a number of communication satellites including ones for domestic telecommunication, air traffic control, and maritime communications. In several countries the growth of space

applications has resulted in decreased support for the more basic space sciences. So far this decreased support has been most strongly felt in the sounding rocket area.

Finally, in a number of countries all the members of research laboratories now have essentially permanent rights to their positions. This has resulted in situations such as draftsmen refusing to draw figures for publications since it is beneath their competence (or dignity), etc., The result is that the scientists often end up doing a variety of peripheral tasks to make the program proceed. Also, the size of a group is no longer an indication of its capabilities, since as many as half could be unproductive. Another effect of such government job policies has been that groups have been maintained even when their programs have been terminated. The net effect is that there is appreciably more space-research capability in Europe than is being used. These many partially utilized groups are actively looking for projects in which to participate. The first choice of nearly all of them very probably would be to engage in cooperative programs and experiments with US institutions. There is a variety of reasons for this including the relatively easy working relationships that normally exist, the high technical capabilities in the US program, and the lack of a significant language barrier. However, if such US cooperative possibilities are not forthcoming, then cooperative ventures with countries such as the USSR will probably be increased to fill the vacuum (of space).

Auf Wiedersehen!
(L.H. Meredith)

ULTRAVIOLET TO INFRARED

Ten years ago this year, Dr. J. Borgman established the Space Research Department at the University of Groningen in the Netherlands and proposed that the Netherlands build a satellite for ultraviolet stellar photometry and celestial x-ray studies. This satellite, Astronomical Netherlands Satellite (ANS), was launched by the US on a Scout rocket in mid-1974. It carried x-ray experiments from the US and the University of Utrecht as well as the 22-cm ultraviolet telescope provided by Borgman's group. In spite of the highly eccentric orbit produced by the Scout, the satellite has met all its original scientific objectives and had a useful orbital lifetime of about 18 months compared with the operating lifetime of six months for which it was designed. The poor orbit, however, has resulted in the satellite's being of very limited scientific use after mid-1976 and in its projected re-entry into the earth's atmosphere in February 1977.

The early demise of ANS is unfortunate since it has the capability of observing objects as faint as 13th magnitude and has about 30% photometric accuracy in each of its five spectral bands (the bands are centered at 1550, 1800, 2200, 2500, and 3300 Å). However, a number of groups are participating in the analysis of the substantial amount of data that have already been taken on a wide range of types of celestial objects. At the University of Groningen, which I recently had the opportunity to visit, the analysis is concentrating on studies of the extinction of stellar fluxes by the interstellar dust. They observe a peak in the absorption at 2200 Å for every stellar source they have investigated, with only one possible exception. This result is similar to that found with the European Space Agency TD-1 satellite and reported in ESN 29-12:558.

Closely related to their studies of the properties of interstellar dust by the measurement of its absorption of stellar ultraviolet light has been their program to measure the infrared emission of the dust grains and gas in ionized regions of the interstellar medium, HII regions. This part of the program was started in 1968 and has included the flight of about three balloon-borne gondolas each year since that time. Initially their gondolas carried two 20-cm dia. telescopes which scanned the sky in elevation by means of a rotating flat mirror. Each flight made observations in two wavelength bands in the 30 to 200-μm region. The bands were established by multiple reflection restrahlung filters and were relatively broad with resolving powers ($\lambda/\Delta\lambda$) of about three. More recently they have employed a single 40-cm telescope gondola system in which four different restrahlung filters can sequentially be used to make measurements on a given source. In the future they plan to shift their balloon program from this relatively broad band spatial mapping work to higher spectral

resolution programs in order to study such things as the composition of both the dust grains and the interstellar gas clouds. In part this shift in program emphasis is being forced by competition from the NASA program of conducting celestial infrared observations from high-flying aircraft.

The success of the ANS project, coupled with the group's history of work in infrared observing programs, led them in 1974 to propose an infrared astronomy satellite project (IRAS) aimed at performing a full sky survey using an ANS type spacecraft. Similar scientific concepts had evolved in the US, and a combined effort to study such a satellite was subsequently initiated. In jointly optimizing the mission, however, the satellite weight grew by well over a factor of five from that of ANS--IRAS now requires the use of a Delta instead of the earlier Scout launch vehicle. Furthermore, while the basic ANS system concepts remain, essentially all the existing spacecraft subsystems now require upgrading. Thus, from the Dutch standpoint, the project has moved from one to repeat the ANS spacecraft (essentially zero new technology) to one which pushes the technology in nearly all areas. This shift could well be crucial to final approval for the IRAS since adequate money for the Dutch portion of the project appears to be largely available from a budget established to support advanced technology development in the Netherlands but not from their national science budgets.

If the IRAS project is approved, it is anticipated that the US will provide the infrared telescope and launch services. It is also likely that the UK will participate directly with the Dutch by providing satellite operations and data reduction support through their Appleton and Rutherford Laboratories respectively. The UK might also provide a long wavelength (150-300 μm) detector. Participation by the British would probably make it possible for Borgman's group to build an infrared spectrometer for inclusion in IRAS within the Netherland's 110 M guilder ($40 M) total IRAS budget. Such an instrument would have a resolving power of about 20 in the 7-20 μm range and would fit in well with the previously mentioned plans of the group to move to higher spectral resolution observing programs.

The system studies for this new infrared satellite project have recently been completed, and final approvals are confidently expected by this fall. Furthermore, a document fully describing the technical details of IRAS was jointly published by the Netherlands and the US in May 1976. A brief outline of the IRAS characteristics is probably appropriate here, however, so that those with a general interest will know the kind of capability that is planned to be in orbit by 1981: (1) 60-cm-dia. telescope cryogenically cooled to 10 K; (2) the prime survey to be conducted in four bands (8-15, 15-30, 30-60, and 60-120 μm); (3) sensitivity limited by the zodiacal light background in the shortest two bands (about 1000 times more sensitive than the current AFCRL infrared survey); (4) capability for including additional instruments (i.e., long wavelength detector and spectrometer); (5) source positional accuracies better than 1 arc min; (6) one-year life in orbit to permit observing all regions of the sky about 10 times; (7) data obtained to be generally made available include: a) printed catalogue of the "most interesting" sources (10,000-30,000 sources); b) tape catalogue of all point sources (10^6-10^7 sources); c) full set of infrared survey transparency overlays for the Palomar Sky Survey. From these capabilities it is apparent that IRAS could produce major advances to the understanding of many astrophysical problems ranging from the origin and composition of interstellar matter, to the process of star formation, to the high infrared emission by some galaxies. At least as important, it could both determine the contribution of the infrared spectral region to the energy balance of the universe as well as identify all the naturally occurring infrared sources in the sky that are brighter than the general sky background. (L.H. Meredith)

ONRL REPORTS

See the back of this issue for a list of current abstracts and how to obtain the reports.

BEHAVIORAL SCIENCES

21st INTERNATIONAL CONGRESS OF PSYCHOLOGY

This very large Congress, held in Paris from 18-25 July, was attended by over 2500 persons representing almost 60 countries. It was organized by the International Union of Psychological Sciences and the French Society of Psychology. The former has 41 member countries and represents over 60,000 psychologists. There also were about 50 exhibitors at the Congress, primarily publishing companies and manufacturers of specialized laboratory equipment.

The organization of the Conference was designed to maximize the opportunity for discussion, a difficult task for such a large gathering. The technical meetings were divided into symposia and thematic sessions. The symposia in turn were divided into two three-hour periods. The first period contained four reports and a review of a particular topic, while the second period was devoted to a discussion involving those giving oral presentations and those whose papers were accepted and printed in the proceedings but not presented orally. The general audience could take part in these discussions if there was sufficient seating in the meeting rooms. The thematic sessions also were three hours in length and comprised of a series of 15-minute papers and discussion. The general idea was good, but because there were four simultaneous symposia and four simultaneous thematic sessions plus the discussion groups, there could be as many as 12 meetings going on at the same time, which produced a definite choice-anxiety amongst the participants.

The organizers in addition to providing simultaneous interpretation between English and French performed a valuable service, considering the many nations represented, in distributing complete sets of pre-prints containing rather detailed abstracts.

As with any meeting of this size the quality of the papers ranged from outstanding to extremely poor. Even when taking into account the fact that frequently one's name must appear on the program in order to obtain funds to attend such meetings, it was disappointing to see slides dated 1969. If data of such vintage (1969 was a good year) are to be presented, it would seem astute, to say the least, to remove the dates.

In the session entitled "Physiological Basis of Learning and Memory," two papers were of particular interest. The first, presented by R.W. Doty (Univ. of Rochester), was "Ionic" Versus "Molecular" Memory--Are Some Neurons Specialized for the Latter? Doty says that memory falls into the two broad but distinct categories given in the title of his paper. Activity of neurons is reflected in altered metabolism and ionic balance, and the subsequent behavior of these neurons will be influenced by these changes. Effects postulated as being ionic are closely restricted to the pathways activated and are basically temporary, whereas molecular memory is permanent and is produced through alteration of some molecular constituent of the participating neurons. Doty's basic question was, "Is it possible that molecular memory occurs only in specialized neurons?" He showed an excellent series of slides of histological preparations in which he pointed out specific neurons in the brain which he found to be related to memory in the macaque monkey. He based this conclusion on the fact that when these areas (primarily in the *corpus callosum*) were blocked, the animal could not learn to respond to a new conditioned-stimulus nor could he respond to one already learned.

A paper by C. Pearlman (Boston V.A. Hospital) addressed the importance of rapid eye movement (REM) sleep with respect to learning. During REM sleep, sensory input and motor activity are inhibited, but most of the brain paradoxically is more active than when awake. It has been shown in several investigations that there is a chance to consolidate learning without disrupting ongoing behavior as would occur in the waking state. It has also been shown that deprivation of REM sleep during various stages of learning actually impairs or inhibits learning. Although much work has been done relating to this phenomenon, Pearlman points out that little is understood about the underlying mechanism and that we should devote increased effort in this direction if we are to understand better the complex roles of memory and learning in daily life.

M.R. Rosenzweig (Univ. of Calif., Berkeley) reviewed this session,

pointing out that we know very little of the biochemical and/or hormonal basis of learning and memory. He also commented that the study of brain mechanisms and learning is a growing and resurgent field after a dearth of activity in the 50's and 60's. The recent revival is due to improved neurological laboratory techniques, particularly those which are non-intrusive.

A session related to the above in some respects was the one on "Pharmacology and Behavior." An excellent presentation was made by K. Taeuber (Medizinische Abteilung, Hoechst AG, Frankfurt) who summarized a recent computer search of 1500 papers published between 1973 and 1975. While many aspects of psychopharmacology were included, the vast majority of papers were found to be concerned with the effects of abusive drugs such as cannabis, amphetamines and alcohol. He found that there was an incredible lack of systematic methodology in these studies, rarely an attempt to relate the study to any theory, and perhaps more significantly, a lack of sound experimental design. For example, blood levels of drugs in the subjects frequently were not obtained, often there was failure to take a personal case-history, laboratory techniques were selected for convenience and fashion rather than for obtaining useful data, and finally the population from which the subjects were obtained often was not identified. A particularly interesting point made by Taeuber was that very often the psychopharmacologist does not really study the most relevant parameters at all. For example, "...when screening a new drug with potential antidepressant activity in healthy volunteers, the psychopharmacologist is actually interested in predicting therapeutic efficacy in patients. The relevance of his efforts with healthy people is difficult to see." A related example is the extensive use of performance as a measure of the effects of various drugs when it is known that performance is not one of the central problems in most psychic disorders. Thus according to Taeuber, "...pharmacopsychology appears to study most intensively what is least interesting or relevant."

P.L. Carlton (Rutgers Medical School) reviewed some of the current practices in psychopharmacology and concluded that some actually are impeding progress in this important field. He also raised the issue of validity of conducting drug experimentation on normal humans. The point he stressed most was the lack of a theoretical basis for most studies and similarly the lack of using models adequately. He feels there is a lot of sloppy thinking in the field and that we must stress the theoretical development and not be completely satisfied with treatment of symptoms. This same theme was also mentioned by other speakers. To quote Carlton: "Psychopharmacology needs a shot in the arm, and new theories can do this."

K. Wesnes (Reading University, UK) reviewed the effects of psychoactive drugs on human behavior. He discussed the effects of various drugs on mental performance, psychomotor performance, perception, and learning and memory. While his talk contained much detailed information, a general conclusion is worth mentioning here. Although it can be established that a particular drug can produce behavioral changes in an individual who has had no previous experience, it has not been demonstrated that these changes will continue to be elicited on repeated administration. For example, there is little evidence from studies using habitual smokers that nicotine thus administered enhances performance relative to non-smokers, but rather that performance is enhanced when compared to the smokers without tobacco. This suggests that smokers become dependent upon tobacco to achieve "normal" functioning.

Another of the sessions attended by the writer was entitled Psychology and Ecology. Of the four speakers, three were from Stockholm. B. Gardell (Swedish Council for Social Science Research) spoke on "Psychological and Social Problems of Industrial Workers in Affluent Societies." While many issues were discussed by Gardell, he emphasized the relation between occupation and quality of life, and the impact of mass production on political and social life. It was his opinion that affluent societies who regiment the average worker offer a low quality of life which is reflected in many ways, including a high percentage of workers on "sick leave." For example, in Sweden about 15% of the workers are routinely on sick leave (the writer has heard even higher numbers on other occasions) at any one time, and according to Gardell the cause of 75% of these 15% in 1975 could be traced to job

dissatisfaction rather than medical reasons. He, as did all the other speakers, emphasized that an important role for psychologists in a social and ecological sense, is to present the results of their research in a way such that they can be readily understood by political leaders and the general public and therefore have an impact on public policy. Psychologists as a profession were scolded in some ways for not addressing the real social issues.

As pointed out by R.W. Russell (Flinders University of South Australia), we humans proudly point out how we can adapt to almost any situation whether it involves heat, cold, long hours, smog, etc. Russell and other speakers emphasized that while we can adapt, we pay for it in many ways both mentally and physiologically. Behavioral and physiological plasticity can carry us only so far, and then something has to give whether it is due to photo-chemical pollutants on the freeways, carbon monoxide in industrial plants, or stress caused by a rapid pace of living. The overall message of this session for psychologists was to address real problems and work hard to implement their results in the public interests.

Clearly the most volatile session of the entire Congress had to be the one entitled Deontology (the ethics of duty). This session, the afternoon of the last day, was concerned with a problem that has always plagued psychologists, namely the impact of and ethical considerations involved in using human subjects for scientific investigation. Several countries have developed codes of ethics addressing this problem. P.D. Reynolds (Univ. Minnesota) presented the results of an international survey initiated in 1973 for the purpose of assessing existing codes of ethics in different countries. Twenty-four codes were returned representing 21 countries. In general, (although the survey has not been completed) it was found that, in addition to differences on basic issues, it is very expensive to arrive at agreement on codes; and it was agreed at the Congress that to expect international agreement on a single code at this time is unrealistic. An interesting issue is the role of the subject (who, by the way, is now frequently referred to as a participant or respondant) and whether the benefit of results of experiments is justifiable when balanced against possible harm (mental or physical) to the subject.

An extremely emotional presentation was made by Ms. A.L. Vasquez (a Chilean Psychologist now at the University of Caen, France) concerning the current role which she stated was being played by psychologists in Chile with respect to the application of psychological techniques to human torture. Vasquez said that she and her colleagues, while still in Chile, had occasion to treat many victims of mental torture over a two-and-a-half year period and could therefore speak on a first-hand basis. In addition to describing the techniques used, Vasquez alleged that, in Chile, psychological techniques are being refined and behavior-modification methods developed for the express purpose of improving the effectiveness of human torture. She appealed to the Congress to take a formal stand on these issues. The presentation was well delivered, well documented, and emotional. Vasquez received a standing ovation at the conclusion. The International Union of Psychological Sciences adopted a formal resolution on July 22nd condeming such practices.

All in all the Congress was interesting and it is regrettable that one could not attend more than one session at a time. The present article is only a smattering of the information presented. Proceedings will be issued sometime in 1977. (J.W. Miller)

BIOLOGICAL SCIENCES

HUMAN LEUCOCYTE ANTIGENS (HLA) AND DISEASE

The First International Symposium on HLA and Disease was held in Paris, France, 23-25 June 1976. The conference was organized under the patronage of the Minister of Health Mrs. Simone Veil, and under the sponsorship of the French National Institutes of Health and Medical Research, the National Center of Scientific Research, and the General Delegation of Scientific Research and Techniques. The symposium took place at Porte Maillot, in the Palais des Congrès, a large and well-furnished hotel complex designed to accommodate multiple conferences.

It was appropriate that the meeting be held in France, since it was the French scientist, J. Dausset,

who published the first evidence for human leucocyte antigens. Dausset has continued to be a "leader" in this field, and served as chairman of the Symposium. He pointed out that studies of the HLA system and its relationship to disease offers the ability to predict which individuals are susceptible to various diseases; the significance of this lies in the possibility of preventing an illness by altering exposure to the causative agent.

In the way of an introduction, a brief review of relevant background material, not part of the Conference, is provided.

Physicians first attempted to transfuse blood in the 16th and 17th centuries, but the practice lapsed into disuse because of the frequent demise of the patient. The reasons for the untoward reactions were a mystery until 1904 when Landsteiner discovered that some people had proteins in their serum that agglutinated the red blood cells of others. Using these serums he defined the major blood types known today. The letters A, B, AB, O represent the kinds of antigen (products that stimulate antibody production) one has on one's red cells. When a person is exposed to an antigen not on his red cells, antibodies are produced against the foreign antigen. Antibodies are complex globular glycoproteins that have the unique property of combining specifically with the inducing antigen and are produced by a special class of lymphoid cell known as a plasma cell.

In 1954 Dausset observed that certain frequently transfused patients had antibodies in their sera that reacted with leucocytes (white blood cells). The suggestion was made that the transfused foreign leucocytes carried antigens different from red blood cells that would stimulate antibody production. Dausset found that sera from his patients would react with leucocytes of about 60% of the French population, and soon other workers found similar serum antibodies in transfused patients and multiparous women. There are currently more than 40 different antigens that can be detected on human leucocytes using immune serum from patients.

It was later shown that these leucocyte antigens were inherited, and belonged to a genetic system that in 1968 became known as the Human Leucocyte Antigen System (HLA). It is now known that the genes which are responsible for the production of the HLA antigens are found on Chromosome No. 6 and reside on a segment of chromosome equal to about 0.1% of the total genetic material for a given cell. Within this small segment are four distinct areas or loci called A, B, C, and D. The genes (segments of DNA directing protein synthesis) at each locus control the production of a particular HLA antigen on the leucocyte cell surface. Each person has two alternate forms of the same gene (alleles) at each of the loci, and therefore two HLA antigens for each of the four major loci. As there are 15 types of A antigen, 21 types of B, 7 types of C and 10 types of D, a theoretical probability of having 20 million different types of individual exists. If one were HLA typed, the results might look like this, A1, B8, C3, D6 A2, B27, C6, D9, where an offspring inherits one series from each parent. A, B, and C locus antigens have been defined by serum antibodies, while D locus antigens are measured in a mixed lymphocyte culture (MLC). When lymphocytes from two individuals are mixed in tissue culture, they stimulate each other to divide. This event can be easily detected by measuring the uptake of radioactivity labeled amino-acids into the responding cells. This reaction is due to the fact that lymphocytes recognize cells with foreign antigens, and the particular antigens recognized in this response are controlled by genes in the D locus area of the HLA complex. By using this MLC test, about 10 different D locus antigens have been found. The HLA System is the most complex genetic system known to exist in man.

Subsequent studies showed that skin grafts between HLA identical (having the same HLA antigens) siblings survived much longer than skin from HLA dissimilar siblings, suggesting that these were the antigens that induced an immune rejection response when tissues were transplanted, hence were the major histocompatibility antigens in the human. This hypothesis proved to be correct, and persons receiving kidney and bone marrow transplants are now HLA-typed to insure as close a match as possible with the donor.

A similar antigenic system operates in the mouse and is known as the H-2 system. In 1964 F. Lilly and colleagues described an association between the development of viral

leukemia in mice and H-2 types. It was only a short time before the first studies on HLA antigen frequencies and human tumors were available, and during the past ten years a tremendous amount of new information has accumulated concerning the association of the HLA genetic system and certain disease processes. The aims of the First International Symposium on HLA and Disease were to allow the biologists and the clinicians to meet and discuss the implications of this rapidly evolving field.

A. Svejgard of Copenhagen outlined how studies associating HLA antigens and disease were performed using either population or family studies. Population studies are carried out simply by typing a number of unrelated patients with a given disease and comparing the frequencies of the various HLA antigens with those observed in a random sample of healthy unrelated controls. The strength of the association between HLA type and the disease is expressed as the "relative risk" and indicates how many times the disease occurs more frequently in a group of individuals carrying the HLA antigen relative to a group lacking it. A relative risk higher than 1.0 indicates that the frequency of the antigen is increased in the patients. In general, the strength of an association (relative risk) reflects biological importance, since the strength of an association may be strong but statistically insignificant if the sample size is small, whereas a weak association may be significant if the sample size is large.

Studies on families with more than one individual suffering from a disease are carried out by typing all of the members for as many generations as possible and using statistical techniques to look for increased occurrences of the illness associated with a particular HLA antigen. Needless to say, these studies are difficult, as at least 20 affected family individuals must be studied before any reasonable level of significance can be reached.

Dausset discussed the clinical implications of the HLA typing data, suggesting that the diseases showing a correlation were often of unknown pathophysiology and frequently exhibited a wide range of immunologic abnormalities. That said, the remainder of the Conference addressed a virtual Pandora's box of seemingly unrelated diseases except for their correlation with HLA type.

Strong associations were shown for a few diseases. Ankylosing Spondylitis (a type of lower spine arthritis) was associated with the HLA type B-27, with a relative risk (RR) of 81, indicating that the disease is 81 times more common in people carrying B-27 than in those lacking it. Psoriasis, a skin disease, was associated with B-13, having an RR of 4.3, whereas celiac disease, an intolerance to gluten, causing gastrointestinal disease; Chronic Immune Hepatitis; and Myesthenia Gravis all were associated with B-8, having RR's of 9.5, 3.6, and 4.4, respectively. Graves disease (hyperthyroidism) and Addison's Disease (malfunctioning adrenal glands) were also associated with B-8, RR's being 3.6 and 6.4. Multiple Sclerosis exhibited an association with Dw-2, Schizophrenia with A-28, and Juvenile Diabetes with Bw-15, with RR's of 5, 2.8, and 2.1, respectively. Noticeably absent from the list are the hoped for correlations with malignant diseases, the cripplers like Rheumatoid Arthritis, the difficult allergy problems including asthma, and the susceptibility to many infectious diseases. This may in part be accounted for by the fact that only A and B series antigens were examined in any depth, as the C and D series are relatively recent discoveries. There was a strong consensus suggesting that many diseases would show significant correlations with the C and D series antigens, as this segment of the chromosome carried the so-called Immune response (Ir) genes, those genes controlling the immune responses to various challenges such as microbial invasion. The mechanisms by which HLA influences certain diseases is unclear at present, although much speculation was generated on this point, most revolving around the Ir genes being somehow involved.

After all this, one might rightfully ask what benefits have arisen from HLA typing. In reply, it could be pointed out that HLA typing is extremely useful in paternity testing, in kidney and bone marrow transplantation, and in certain blood transfusions where platelets and granulocytes are typed so as to be identical with the recipient, avoiding certain transfusion reactions. The major value lies in the potential of the typing to detect patients at risk from certain diseases in time to allow for preventive therapy.

The meeting ended on an optimistic note; researchers expect to find more associations, some of which may give

hints concerning the mechanism of the disease process.

The proceedings of the meeting will be published by Munksgaard International Publishers, Ltd., 35, Norre Sogade, DK-1370 Copenhagen K., Denmark, later this year.
(J.N. Woody, University College, London)

HYDROCARBONS, ENZYMES AND CYBERNETICS--A MIXED BAG

With an enforced but far from unwelcome weekend by the sea while waiting to keep a Monday appointment, I can be forgiven, I hope, for writing idly about matters of which I am almost totally ignorant and for compounding the sin by bringing together topics which are connected mainly by trivial circumstances involving myself: I conversed with three persons, within three days, in Italy, about three different things. Two of these are physicists and two are associated with the research arm of a huge Italian holding company. Thus there are two pairs with something in common, and I propose to follow the resulting train of associations: the hydrocarbon industry; how the industry supports applied microbiological research, especially on the industrial uses of enzymes; how basic research on enzymes must underlie the applied research; how a physicist associated with these activities looks at enzymes; how the second physicist looks at the nervous system; and where will these physical incursions into biology lead us?

The Italian National Hydrocarbon Authority, ENI: The organization to which I referred is ENI, a holding company founded by government investment through parliamentary appropriations. In 1972 the investment was a teralira (10^{12}) or roughly a gigadollar. The Authority is supposed to promote and implement "projects of national interest in the field of hydrocarbons and natural gas..." and the "chemistry and research, production, reprocessing and sale of nuclear fuels, along with all mining activities within the nuclear sector."

The four operational sectors of ENI are: Oil and Gas, Chemical and Nuclear, Engineering and Services, and Manufacturing. Research and Development falls under Engineering and Services and is the responsibility of Snamprogetti, an organization with engineering, contracting and R&D laboratories in several countries--including the US--and worldwide operations in construction of petrochemical and nuclear facilities, pipelines and refineries. The main R&D laboratories are in Milan, where laboratory studies of new processes and industrial products in the petroleum and petrochemical fields are carried through the pilot-plant stage and then prepared for marketing and industrial use. Basic research and research on microbiological processes is done at the Monterotondo laboratories some 20 km outside Rome.

Snamprogetti Monterotondo Laboratories. Immobilized Enzymes: A visit arranged at short notice took me to the Laboratories for Biochemical and Industrial Microbiological Research where I was briefed by a management representative, Dr. Salvatore Firrisi. Several projects were touched on very fleetingly: new methods for optical resolution of phosphine racemates by asymmetric reduction; production of single-cell protein from alcohols; control of marine oil pollution by providing nutrient for microbes capable of degrading hydrocarbons.

More details were available on immobilized enzymes. The work at Snamprogetti, taking advantage of close contacts with polymer technology, has apparently resulted in a number of very stable enzyme systems which have proved successful both in preparative and analytical biochemistry. A description of the basic process has been published by Dr. D. Dinelli, vice-president of Snamprogetti. An aqueous solution of enzyme forms the disperse phase of an emulsion in which a polymer solution is the continuous phase. The emulsion is extruded into a coagulation bath to form fibers of polymer in which the enzyme is entrapped. The thread is wound on rollers, vacuum-dried, and formed into skeins for storage. The process will be recognized for its resemblance to one familiar in the preparation of microencapsulated enzymes, but the fibrous habit offers decisive advantages. Enzymes used in this form in industrial processes include penicillin amidase in the preparation of semisynthetic penicillins, β-galactosidase for reduction of the lactose content of milk, invertase for hydrolysis of sucrose to glucose and fructose, and amino acylase for optical resolution of amino acid racemates. I was shown an invertase column formed of

cellulose triacetate fibers which had been in use for many months. Aside from a little bacterial contamination, which I was assured didn't matter, it was still almost as good as new.

The Fluctuating Enzyme: My main reason for wishing to visit Monterotondo was the hope of meeting Dr. Giorgio Careri, author of a novel--to me--theory of the special properties which confer upon a protein the ability to accelerate chemical reactions. Careri was not there, but I was able to meet him later at the Institute of Physics, University of Rome. Formerly Director of Research at Monterotondo, he now divides his time between the two institutes. In September 1976 he will take up the position of Sherman Fairchild Distinguished Scholar at the California Institute of Technology.

The paper "The Fluctuating Enzyme" may be said to suggest a missing link in our understanding of enzyme action. It is widely if not universally agreed that a sizable amount of free energy must be available at the active site in order to produce the enormous increase in reaction rate *vis à vis* that occurring in absence of the catalyst. Since spontaneous conformational changes in the macromolecule involve only small free energies, it is often supposed that provision must exist for a sequence of such Gaussian fluctuations to act additively. However, such a sequence would by definition be a random one, while the free energy needed for substrate activation would presumably have to be provided either simultaneously, or according to some particular time sequence, and vectorially. Since there is little evidence for the coupling between groups within the active site that such a mechanism would require, the mechanism of "focusing" or "coordinating" the change has remained a mystery.

Careri's proposal, if I understand his statement of it, is that the coordinating influence originates in the surroundings, not in the active site. It may, for example, consist of a generalized electrostatic field arising from a large (non-Gaussian) fluctuation in the solution. It is this field which simultaneously affects the responses of all the groups involved in the active site, and which, in other words, determines their spatial and temporal pattern. If the spatial and temporal pattern of change in a particular region is that programmed, so to speak, for a particular chemical change, then the reaction will be catalyzed and the macromolecule will be an enzyme.

The suggestion is, in principle, amenable to experimental test by looking for correlations between large electrostatic fluctuations and the motions of probes locating the active residues during an enzymatic reaction. Careri here simplifies the practical problems by assuming that the postulated correlations should still occur if one deals "with the mean value of the Gaussian distribution instead of the more energetic displacement." The remaining experimental difficulty is the search for suitably sensitive independent probes.

This search is proceeding at Monterotondo along several lines, Careri told me, directed towards solving the problem in the case of lysozyme, which has the best documented active site. (1) A change in the surface charge is being induced by nanosecond laser irradiation of a light-sensitive phenol derivative attached to the enzyme: will this induce a correlated change in the macromolecule conformation? (2) Apparatus is being built, and should be ready by January 1977, to measure cross-correlation of modulation of surface ionization (noise) and fluctuation of spectral absorption or fluorescence. (3) The fluctuations in the infrared spectra of protein layers with different contents of water (<20%) will provide information on the fluctuation of the hydrogen-bond network and will be combined with measurement of fluctuations in diamagnetic susceptibility and dielectric content.

With increasing appreciation of the information content of noise in biological systems, all this may seem less alien now to biochemists than it did when Careri first put forward his ideas.

Cybernetics at Arco Felice and Salerno: If physicists and enzymologists are occasionally at odds, what of the cyberneticists and the physiologists? I learned a little about this, with limited comprehension, from Dr. Caianiello, Director of the CNR Laboratory of Cybernetics at Arco Felice near Naples and Professor of Theoretical Physics in the University of Salerno, who generously described his personal interests and those of his staff.

To begin with, he risked a definition of cybernetics. It is the

study of any system by the method of physics using the technology of mathematics; it is necessarily an interdisciplinary field and one, he said, that can be pursued only in an atmosphere of enthusiasm for the contributions that the several disciplines are capable of making toward the common goal. Many of Caianiello's ideas are being developed in depth in Japan, where presumably such an atmosphere exists.

His main interest in the study of intelligent behavior was preceded by development of a mathematical model of nervous activity, a model differing from biological models in that to achieve conceptual and mathematical tractability, it discarded many biological essentials, retaining only the basic feature of the neuron as a binary (non-linear) element susceptible to all-or-none excitation. An array of other neuronal 0 or 1 inputs to the central neuron provides a stimulus which is proportional to the number which are firing: thus h neurons contributing with weighting factors $k \ldots k_h$ provide a stimulus either above or below the threshold s_h which leads to excitation (1) if positive and no response (0) if negative, after a delay time τ. This leads to a neuronic equation which has been solved by quantum-field physics for various cases. For the single neuron, with addition of a constant α representing decrement (refractory state), a parabolic relationship between spike frequency and stimulus was obtained, which was ridiculed at the time but since has been demonstrated to occur in nature. A second case studied dealt with coupling coefficients and led to neuronic equations which incorporate learning into the model and are capable of accounting for (or at least representing) the remarkable fact that post-electroshock amnesia lasts half an hour, one million times longer than the neuronal response time of 1 msec. Caianiello asserted that all the facts of neurology can be qualitatively represented. The implications, including design of a computer which learns and one which operates on a system of multivalued logic, are being investigated by computer simulation in Osaka.

His recent work pursues a long-standing interest in the structure of language and articulated thought, seeing how letters are combined into syllables and how the combinations can be set up most economically. He is searching for new principles as the system gains in complexity perhaps involving structured and hierarchical systems like the system of cardinal numbers. This endeavor leads him, on the one hand, to examine the analogy of a decimal hierarchy in monetary systems and, at the other extreme, to analyze classic texts in several languages.

Where does all this lead us? Obviously the people who prepare immobilized enzymes, and their sponsors, are not repelled by the fluctuating enzyme despite its mathematical-physical-chemical ancestry from Langevin through Landau to Kirkwood and Onsager, perhaps because success would open up a new chapter in the book of practical enzymology. I am not so certain about cybernetics and can only quote the opinion of the cyberneticist, F. H. George, who in 1960 invited the biologists "to take the method of theory and model construction seriously and explicitly; no harm can possibly be done..."-- to which he added the personal opinion that "when biologists realize the power inherent in cybernetics, biology will progress with something like the same speed as physics in the nineteenth century." Well, here by the sea there are many grains of salt; but if you had met Caianiello you might feel that it would be an impertinence to be seen using them. (J. B. Bateman)

POLYMER CHEMISTS MEET IN PRAGUE

The Prague Meetings on Macromolecules (PMM) have taken place regularly during the summer at the well-known Institute of Macromolecular Chemistry, Prague. This year, there were a number of important changes. During the week of 12-16 July, a much larger number of scientists, about 250 (half from Western Europe and half from Eastern Europe, 21 countries in all) attended the PMM. This happened because there were actually two meetings: the 16th Microsymposium on Macromolecules entitled "Advances in Scattering Methods," and the 5th Discussion Conference entitled "Phases and Interfaces in Macromolecular Systems." Dr. B. Sedlacek, the organizer of the Microsymposium and editor of the proceedings, said that the two meetings on "a tool and a problem," respectively, were originally scheduled for successive

weeks. However, timing problems forced the organizers to hold them simultaneously, and in the larger facilities of the Czech Technical University. This led to some innovations in the organization of the meeting.

Because of the parallel sessions it was not possible to attend both meetings, and I chose the Discussion Conference. A brief sketch of what occurred during the Microsymposium was given to me by Prof. J. Kratohvil from the Chemistry Dept. of Clarkson College, New York, who is preparing a full summary for the *Journal of the American Optical Society*. Apparently, the major new interest in scattering methods is neutron scattering. Since the ratio of the particle size to the wavelength of the radiation is critical in scattering phenomena, the shorter wavelengths of neutrons have enabled investigators to study a whole new "particle" size range, such as atomic nuclei (H. Benoit, Centre de Recherches sur les Macromolécules, Strasbourg). There was also considerable interest in laser light scattering which yields information about the dynamics of macromolecules in solution (B. Chu, SUNY, Stony Brook). Both new areas as well as the recent developments in other aspects of light scattering were covered. (In this connection I should mention that Tables of Lorenz-Mie Scattering Functions, published by the Institute of Macromolecular Chemistry, were available free at the meeting.)

The Conference on "Phases and Interfaces in Macromolecular Systems," organized by Dr. J. Pouchly, consisted of lectures, discussion papers and poster session contributions, with the aim of providing a range of formats for the interchange of ideas. The lectures introduced and provided a background for a topic, while the scheduled discussions were meant to provide specific problems around which to crystallize active exchange between participants. The formal lectures were, on the whole, good, but the discussions varied considerably in their quality. In one case, at least, the reason for a weak discussion was obvious. Prof. A. Silberberg (Weizmann Institute, Israel), a scheduled speaker on polymers at interfaces, was unable to attend because he was not given a Czech visa in time. He was sorely missed, since he alone on the program combined the theoretical and experimental skills in sufficient measure to bridge the divergent trends that developed in the discussion.

The poster session, a format chosen to cope with the large number of contributed papers in the two meetings, was the most successful part of the program in terms of scientific contact and information transfer. The sessions were well attended, despite the lure of Prague, and the many small discussion groups gave the impression of a busy market place. This format had the additional advantage of bringing contributors from both parts of the meeting together, since the sessions were held simultaneously and in the same room.

As expected, the lectures were primarily on subjects suggested by the title of the Conference. Among these were: statistical thermodynamics of polymer solutions (W.H. Stockmayer, Dartmouth, NH), thermodynamics of polymer mixtures (R. Koningsveld, Geleen, The Netherlands), phase separation (D.J. Meier, Midland, MI), interfacial phenomena in polymer blends (Y.S. Lipatov Kiev, USSR) and adsorption of macromolecules (E. Killman, Munich, W. Germany). The presentations and the discussions that followed tended to deal repeatedly with ways of measuring or calculating the variation of the Gibbs free energy during the formation or separation of a new phase. There was also frequent reference to the behavior of the ΔH and ΔS during the same process and the possible role of the interfacial free energy. Orientational effects at interfaces and at polymer surfaces were also mentioned. The major concerns appeared to be theoretical, even when discussing the properties of specific experimental systems.

In addition to the expected topics there were also a number of presentations on liquid crystal systems. D. Patterson (McGill University, Montreal, Canada) discussed the effects of solute size and shape on order, indicating that alkane solvents can show effects that are quite similar to aqueous systems. He also cautioned that the mixing of solvents (in the absence of solutes) can cause significant changes in thermodynamic functions, a complication in many polymer systems. P.A. de Gennes (College de France, Paris) considered the many forms of lamellar phases in polymers, and indicated that these systems are easier to treat theoretically than the more common lipids (which are too long to treat as a simple molecule and too short to apply polymer statistics).

R. Lefever (Université Libre de Bruxelles, Belgium) presented a talk on dissipative structures, a rather unusual approach to the problem of phase transition. A dissipative structure is any kind of order that is generated and maintained by the flow of energy or matter. The illustration he used was the classic oscillating chemical reaction due to a feedback step in the kinetics, so it was not immediately obvious how to apply this thinking to a physical change which involves a latent heat rather than a dissipative flow of energy. Nevertheless, the ideas were stimulating in the context of the meeting.

The distribution of molecular weights in polymers is well known, but a distribution of conformational states is apt to have as strong an effect on physical properties. S.Y. Frenkel (Academy of Science, Leningrad, USSR) drew attention to this fact by considering the free energy distribution in flexible chain polymers. The lower free energy of extended chain crystals *vs* folded chain crystals leads to a range of physical properties, e.g., melting point, and to irreversibility.

Z. Tuzar (Institute of Macromolecular Chemistry, Prague) described how a block co-polymer in a solvent that is selective for one of the components can lead to the formation of micelles. Poly (styrene/butadiene/styrene) in isopropyl acetate (selective for styrene) forms spherical micelles having about 100 polymer molecules, with the poorly soluble parts at the core.

The formation of micelles and the organization of lamellar (liquid crystalline) phases discussed earlier suggest that polymer molecules have the classic properties of much smaller surface active molecules. The papers that dealt with adsorption of polymers emphasized this point. However, the sizes of individual polymer molecules can approach those of dispersed phases, and it is possible that some polymer systems can be treated as macroscopic systems with interfacial free energies. This was the subject of the paper I presented (M. Blank, Columbia University, NY). In attempting to evaluate the energetics of conformational changes in a biopolymer I calculated the free energy by assuming that the area of contact between the biopolymer and the aqueous solvent could be treated as if it were an interface. With this approach it was possible to use data on the changes in the molecular properties of hemoglobin as a result of combination with oxygen, to calculate the variation of the equilibrium constant of the reaction.

There were several other papers dealing with the properties of biopolymers and their roles in biological problems. Virtually all of these were concerned with aggregation phenomena, e.g., the association of chromatin (L. Karawajew, M. Bottger, J. Behlke and H. Fenske, Berlin, DDR), the assembly of microtubule protein (H. Muller and J. Strassburger, Jena, DDR), the formation of high molecular weight protein in the human lens as a cause of cataracts (G.B. Benedek, MIT, USA) as well as papers on the properties of nucleic acids in solution. A presentation by E. Palecek (Brno, Czechoslovakia) on nucleic acids outlined the conformational changes and denaturation kinetics in the high electric fields at charged interfaces.

Although the Conference title might lead us to expect many contributions in surface chemistry, there were relatively few. L. Ter-Minassian-Saraga (CNRS, Paris) described how one obtains interfacial entropies from contact angle studies, and in a second paper how the adsorption of ions on a polymer alters the adhesion properties. A presentation by B.J.R. Scholtens (Wageningen, The Netherlands) described the influence of adsorbed polymers on electrolyte transport across a liquid/liquid interface, and G.J. Fleer from the same University considered the adsorption of polyvinyl alcohol on silica by ellipsometry. H. Steinbach (Bayer, Leverkusen, W. Germany) gave evidence from film balance studies for the association of discrete numbers of water molecules with the hydrophilic groups on polydimethylsiloxane.

All told, there were over 100 presentations at the PMM this year, most of which will be published in the *Journal of Polymer Science-Polymer Symposia*. I can only echo Prof. M. Gordon's (Essex, UK) remarks at the closing session that this was a "rich and successful meeting...at a high level." The emphasis at the meeting was clearly on the macromolecules in the title, but the polymer chemists were confronted with some new ideas from surface chemistry including also biological systems. Next summer, the 17th Conference, on polymers used for *in vivo* applications, will involve the PMM more deeply in the problems of biological interfaces.

(Martin Blank, Dept. of Physiology, Columbia University, NY)

THE MARINE CONTAMINATION LABORATORY NEAR LA SPEZIA

Let me be more precise. La Spezia is the reference point because Americans are likely to know that it is the site of a large naval base. But the traveler by road ignores the La Spezia exit and goes instead to Sarzana, from Sarzana to the edge of Lerici and thence along the winding coastal road to Fiascherino. There, where the Laboratory is situated, La Spezia is mercifully hidden from view; looking out across the Gulf one sees only the shadowy humps of Portovenere worming down to the islands out in the Ligurian Sea.

Coming upon the laboratory at a turn in the driveway one sees a large whitish villa in several styles, evidently enlarged to suit the tastes of successive occupants and now possessed of the cavernous aspect of a structure no longer serving the purpose for which it was intended. D.H. Lawrence, who lived there from September 1913 to June 1914, would be astonished and outraged to see what has become of the house of which he wrote to *Edward Garnett in* 1913, that "I am so happy with the place we have at last discovered...It is perfect. There is a tiny little bay half shut in by rocks, and smothered by olive woods that slope down swiftly. Then there is one pink, flat, fisherman's house. Then there is the *villino* of Ettore Gambrosier, a four-roomed pink cottage among vine gardens, just over the water and under the olive woods. There, D.V., is my next home. It is exquisite."

Exquisite or not, Ettore's *villino* is now in its overblown state the home of what was called, at the time of my last visit in 1971, the Laboratorio per lo Studio della Contaminazione Radioattive del Mare, under the Divisione di Biologia e Protezione Sanitaria of the Comitato Nazionale per l'Energie Nucleare (CNEN). At that time, the chief source of marine contamination by radionuclides was fallout from nuclear explosions, but discharge of radioactive wastes from the nuclear industries was already starting. The Laboratory became involved in assessing the ecological impact of such discharges from the CNEN Trisaia Center into the Gulf of Taranto.

In common with people everywhere confronting similar situations, the Italian scientists must have had no difficulty in asking questions to which they could find no answers. Do we possess a baseline for the "clean" ecology of the region? Where do the discharged radionuclides go, and how fast? What are the respective roles of radioactive decay, sea currents, deposition on the sea bed, incorporation in organic or inorganic complexes, concentration in the bodies of marine organisms, and subsequent transmittal through the food chain, in the dissipation of waste? The questions multiply unasked and each contains a world of uncontrolled variables. The Taranto reports (available to me in title only) provide a clue to the priorities as seen by the Fiascherino scientists: general circulation and "diffusion" in the Gulf of Taranto, and preliminary estimates of the "receptivity" of the chosen outfall area to low level radioactive waste. My visit in 1971 told me something about the kind of laboratory back-up being supplied. Dr. A. Piro was studying the several forms of zinc in seawater--ionic, particulate, and chelated--on the intelligent assumption that radiozinc would distribute itself in the same proportions as stable zinc, and he was making the disturbing observation that ^{65}Zn failed to exchange with chelated stable Zn. Dr. A. Zattera, as head of the phytoplankton unit, had noted that in copepod cultures the zinc was derived from the algae they consumed and not from the free zinc in seawater. At the microbiological level Dr. C. Peroni was developing a method using ^{32}P for autoradiography of metabolising bacteria. Using a device for sampling and incubating the bacteria *in situ* at different depths, he showed that while bacteria are abundant in the surface layers, they are either absent or incapable of multiplying at depths greater than about 200 m. Chemists were devising automated methods of analysis and biologists were measuring the filtration activity of mussels by determining the algal decrement in the ambient water.

These examples are worth recounting because they hint at an approach that is still viable in 1976. There have, however, been fundamental changes in personages and policies. The former director, Dr. Michael Bernhard, has become "Senior Expert," a position that enables him to engage in his important work as consultant to EURATOM, to the Food and Agriculture Organization of the United Nations (FAO) and

to the United Nations Environment Program (UNEP). He works on special problems at the Laboratory and is trying to forge a coherent story from the mountain of Mediterranean literature on oceanography and pollution. Among his many publications a valuable chapter has recently appeared, with A. Zattera, on "Major Pollutants in the Marine Environment," in *Marine Pollution and Marine Waste Disposal*, by Pearson and Frangipane (Pergamon, New York, 1975.) The new Director is the geologist Dr. Aldo Brondi, a most courteous gentleman somewhat haunted by constant administrative demands.

More important perhaps than these shifts of personnel is an expanded mission and an altered chain of command, in accordance with which the title of the Laboratory has shrunk to "Laboratorio Contaminazione Marina, CNEN-EURATOM," which I propose to call MCL. It is now concerned with pollution in general whether caused by radioactivity, toxic stable elements and their compounds, or hot water. At the same time the end product has been defined in strictly practical terms: it must evaluate and recommend sites for nuclear and other installations which require a marine outlet. The corresponding change in the chain of command is significant in that it bypasses the various departments and directorates of the atomic energy authority (CNEN) and thus obviates the risk of internal collusion in obtaining approval of a favored site. The Laboratory now interacts directly with the president of CNEN and, through him, with his Commissione Tecnica per la Sicurezza Nucleare e la Protezione Sanitaria. Further changes are in the making. Industry may be required to do its own site evaluation and to pass on the cost of this, and of pollution abatement measures, to the consumer, leaving to the Technical Commission the responsibility for screening the proposals submitted, rather as Environmental Impact Statements are handled in the US.

From conversations with Bernhard and Brondi I gathered that few active projects are sufficiently far advanced for open discussion. There was the Gulf of Taranto exercise already mentioned. There is much activity in the Gulf of Piombino (on the west coast opposite the island of Elba) where the effects of the discharge into the sea of chemical muds and of iron smelting wastes will probably be compounded by construction of a fuel-processing plant comprising four nuclear reactors, bringing with it complex problems of pollution and conflict with the tourist industry. At the time of my visit the field team was doing a radioecological survey of the La Maddalena Archipelago between Corsica and Sardinia, where a US nuclear submarine support ship is stationed. Mention was made of an example of thermal pollution from a large power station near La Spezia; this arose through discharges into the inner harbor--an error of site selection unlikely to be repeated.

The task of setting up a program to provide background data for site evaluation is seen to be formidable given the mismatch between the long time scale of ecological rhythms and the immanence of new industrial operations likely to modify the ecology rapidly and significantly, if not catastrophically. Bernhard and Brondi understand the inadequacy of the existing ecological foundation and the paucity of information upon which reliable prognoses can be based. An example illustrates the point: the flesh of tuna taken off southern Sicily contains twice as much dimethyl mercury as Atlantic tuna. The reason is obscure. There are heavy metal anomalies of geological origin in the Mediterranean and there are discharges of mercury from the mines near Livorno, but the Mediterranean seawater mercury concentration is no higher than that of the oceans. The answer can only be found in elaborate biogeochemical studies, with special attention to the movement of neritic sediments to deeper waters.

What, then, can this laboratory hope to accomplish in fulfilling its new mission? Fortunately, as seen in the examples from 1971, some worthwhile projects are well established. Others done during expeditions at sea could have been cited. The present staff of about 30 provides one-man coverage of important disciplines: geology, chemistry, radiochemistry, physics, mathematics, physical oceanography, biological oceanography, microbiology, botany (phytoplankton), fish biology--with a notable gap for a zooplankton specialist to represent the first heterotrophic level in radionuclide transfer. A large research proposal submitted to EURATOM consists of two interrelated projects: The first project proposes empirical study of the distribution of pollutants in marine organisms and the implications for the integrity of the environment and the preservation of the good health of man. This will be based on studies of the

"normal" distribution of marine organisms and their population dynamics. Laboratory work will then show the effects of radionuclides and conventional pollutants (mercury, lead, zinc, copper, polychlorobiphenyls, etc.) on marine organisms while studies at sea will lead to better understanding of the role of the different trophic levels in the dissemination of pollutants and especially their entry into seafood.

The second project will involve measurements of physical and chemical factors (including methods and instrumentation) that define the marine environment, and their use in preparing models of pollutant distribution. These, applied to project (1), will aid in understanding and interpreting population dynamics as modified by environmental perturbations.

Lest the ability of 30 scientists to pursue such a large program effectively be doubted, one must remember that the same sea washes many shores, and much cooperation exists with other installations in Italy and within the European Community (EEC). The closest immediate contacts are with the Hydrobiological Laboratory in the Institute of Comparative Anatomy, University of Siena, the International Laboratory of Marine Radioactivity, Monaco, the "Rudjer Boskovic" Institute at Rovinj, Yugoslavia, and--by no means least--a German research team operating near Fiascherino under the auspices of the EEC and the Jülich Nuclear Research Center. In addition to these collaborations, there are in Italy some 25 marine laboratories or university departments concerned with marine pollution. The useful "Directory of Mediterranean Marine Research Centers" (UNEP, Geneva, 1976), with about 110 entries, gives some idea of the extent to which the deteriorating condition of the sea is causing concern among the remaining Mediterranean countries, all of which are represented. A token of concern exists in the participation of these nations, with the exception of Albania, in a project of UNEP and FAO entitled "Regional Cooperation on Protection of Living Aquatic Resources from Pollution and Basis for Biological Monitoring." The program was formulated at an "Expert Consultation" meeting in Rome, 23 June-4 July 1975 and reported in the FAO publication *Pollution in the Mediterranean*. It has much in common with the proposal submitted from MCL to EURATOM. Its substance, with other material, was incorporated in the Convention for the Protection of the Mediterranean Sea Against Pollution--drafted at the Conference of Plenipotentiaries of the Coastal States of the Mediterranean Region for the Protection of the Mediterranean Sea (Barcelona, 2-16 February, 1976).

Another project in which the MCL is active is the EEC-sponsored EURASEP (Nimbus-G), in which zones in European coastal waters have been designated for special study. The Italian zones are in the Ligurian and Adriatic Seas, the Tiber estuary, and the Gulf of Naples. The study will involve aerial infrared scanning combined with data handling equipment and color video recording of sediment transport, estuary dynamics, and chemical and thermal pollution in the target areas. Comparable programs, with differing emphasis dictated by special local conditions, are offered by Belgium, France, Germany and Great Britain.

Looking back at the marine pollution research scene as I see it after visiting MCL, it seems to me that the problem is usually viewed as that of exploring the interactions between three systems--the geophysical-oceanographic, the inorganic chemical, and the biological--and the effects on these of intervening foreign substances and influences. Little or nothing is said about the organic substances always present in traces in the ocean, although they undoubtedly take part in the activities of marine organisms and could easily become rate-limiting when modified or degraded by pollutants. This omission has been recognized by yet another international organization, NATO, and at a symposium on "Concepts in Marine Organic Chemistry" (Edinburgh, 6-10 September 1976), sponsored jointly with ONR, our areas of ignorance will be delimited. It is fitting to conclude this article with the hope that as a result of the NATO-ONR symposium organic chemistry will gain a more favored place in some of the programs I have heard about from Bernhard and Brondi.
(J.B. Bateman)

EDUCATION

A FOREIGN-AID INITIATIVE FROM SPAIN: NEW HIGHER EDUCATION SCHEME FOR STUDENTS FROM LESSER-DEVELOPED COUNTRIES

While visiting the Instituto Quimico de Sarriá, located in a suburb of Barcelona, I came across a very imaginative proposal for educating students from less developed countries (LDCs) in modern technologies. First, a few words about the Instituto, whose energetic and dedicated Director, Dr. Miguel Montagut-Buscas, S.J., has proposed the experiment and is seeking a US foundation's support for it.

The establishment is a 60-year-old Jesuit-operated school of chemistry and chemical engineering accredited by the State and empowered to grant degrees, including the doctorate. It is not State-operated, however, its financial support coming from tuition, research contracts with Spanish chemical firms, and grants from a variety of sources. The need to raise a large part of the Instituto's funding from outside sources has fostered a very alert and creative administration.

The student body numbers about 600 (exclusive of a large enrollment being trained as teachers and others taking vocational courses) and there are about 60 faculty members in the several Departments: physics, analytical chemistry, organic chemistry (which contains a section devoted to quantum chemistry), and a computer center. The Instituto has a fairly extensive selection of modern chemical instrumentation, thanks, in part, to gifts of these instruments by the Federal Republic of Germany and the US Government in 1958 and 1962, respectively. (The Instituto's first gas chromatograph, received as a US gift, is still employed for teaching purposes, and it shares a large laboratory with other more modern equipment, including one of the latest advanced-model gas chromatographs used for research.) Not only does the Instituto have an extensive library of books and journals, but it also publishes its own monthly journal on theoretical and applied chemistry and chemical engineering, a very high-quality publication in all respects.

Montagut's proposal focuses on the problems of training people from the Latin Americas to become modern chemists and chemical engineers. Attempts have been under way for some time to improve the socio-economic condition of Latin America by sending students to the US for education in modern technologies. Very often students of high potential fail to benefit from this opportunity because they have difficulty in adapting to US institutions and society--the difficulty of learning in a foreign language, coping with the much more sophisticated equipment and curricula in our universities, and the general cultural shock of exposure to North American society and tempo. Montagut proposes that his Instituto play the role of intermediary in the education of Latin American chemistry and chemical engineering students, whose final polishing off as modern engineers could take place in the US at a sister institution. In effect, the huge difficult quantum jump ordinarily required of the student would be replaced by two smaller ones that he can make more easily.

By making the initial transition from Latin America to Spain rather than to the US, the student would begin his studies largely in his native language, be embedded in a culture from which his own was derived, and attend an institution intermediate in sophistication between his Latin American schools and those in the US. Moreoever, while pursuing his studies in this somewhat protected environment, the facilities, opportunities, and problems of an industrialized modern society are within reach when he is ready to cope with them. Thus, Barcelona has a considerable chemical industry, and Spain is within easy access of very highly industrialized regions of Europe.

After having made the initial transition successfully, the student would then transfer for final training to a US university (the University of Detroit, with whom Montagut has explored the idea), presumably with major emphasis on the business and economic aspects of the chemical profession, and get exposure to the full tempo of modern technological society. Montagut visualizes that the success rate in the training of Latin American students would be greatly increased by such a trilateral arrangement, and that students returning to their home countries would be much more effective because of this scheme.

The logic of Montagut's ingenious proposal seems very appealing. Moreover, the sponsor--be it a private foundation or a government agency dispensing foreign aid--would get double value for money spent; not only would the primary beneficiaries be helped, i.e., the student and his native country, but valuable support would also be given to an institution in the "transferring" country. In the present instance the principal beneficiaries would be Latin American countries and Spain, but the idea is obviously attractive as a mechanism for giving assistance to LDCs of other cultural heritages. And, of course, its potential applicability extends beyond the teaching of chemistry, or even science, into many other fields of activity where advanced countries may wish to extend foreign aid. (J.H. Schulman)

ENGINEERING

ELECTRICAL ENGINEERING IN EGYPT

The Arab Republic of Egypt covers an area of 386,000 mi^2 (about eight times that of the State of New York) in northeast Africa. It has a total population of about 36 million, and its recorded history dates back more than five thousand years. Few people in the West have knowledge of Egypt's educational system or its research capabilities in science and engineering. Recently an old friend, Dr. James R. Wait, a Senior Scientist at NOAA's Environmental Research Laboratories at Boulder, Colorado, informed me that some Egyptian scientists were to start a research project on the use of electromagnetic waves for probing the depth of the watertable in the arid regions of the country under the US Special Foreign Currency (PL-480) Program and recommended that I visit Egypt. Contacts were made with the Electrical Engineering Departments at the Universities of Cairo and Alexandria, and I was on my way to the Land of Pyramids, albeit in a less-than-agreeable time (July) of the year for visiting that part of the world.

Egypt has five principal universities: Cairo University, Ein-Shams University and Al-Azhar University in the Greater Cairo area; Alexandria University in the north; and Assuit University in the south. In addition, five new universities were recently established in various other regions. Prior to entering a university, students go through 12 years of primary- and secondary-school education. At the end of the 12th year all students are required to take a nationwide examination. Those desiring a university education must attain a certain score at this examination. About 200,0 secondary-school graduates take this examination annually and approximately half qualify for admission to universities. Each student can list up to 24 choices of different universities and departments in the order of preference and the assignment is done by a computer. Of all fields of specialization medicine is the most difficult to get into. Currently a minimum scor of more than 90% is required to be admitted to a medical school. Admission to an engineering school is second most difficult and requires a minimum score of around 84%. Even with this stringent screening procedure, the engineering schools are overcrowded. (I was told that the distance between a student's home and his chosen university and whether or not he is related to a faculty member of the university also enter into consideration, but I do not know how these factors are programmed in a computer. It would seem difficult to devise an equitable formula with these special considerations When a university informs the Ministry of Education that a certain department can take 200 new students, the government is likely to assign 500. There is nothing the university or departmen can do but accept them. With limited university physical and financial resources, some students have to sit on windowsills or in the aisles of lecture halls, and laboratory facilities are overcrowded and have to be shared Judging from what I have seen at Cair and Alexandria Universities, laborato facilities are poor and most of the instruments are very old to begin wit

A BSc degree in engineering in Egypt normally takes five years, including a preparatory year. The Electronics and Communication Engineering Department at Cairo University has a total undergraduate enrollment of abo 1500 in its five-year course, of whic about 250 are in the final year. The attrition rate is quite low. Nine

subjects are taught in the common preparatory year for all engineering students: mathematics (trigonometry, analytic geometry and calculus), mechanics, physics, chemistry, descriptive geometry, engineering drawing, engineering and society, production technology (engineering materials and machine-shop practice), and a foreign language, (mostly English). After the preparatory year, students take courses in their respective departments. The courses in the subsequent four years in the Electronics and Communication Engineering Department seem to follow the traditional electrical engineering curriculum in US schools in the previous decade. All courses are prescribed except one in the fourth year, and students are not taught to use digital computers because the Department does not own a computer. In the final year students are required to do a project which involves the attendance of two-hour weekly lectures supplemented by a full-month's work. Lectures are given in Arabic, but almost all assigned references are US-published books.

The Department also offers MSc and PhD degrees, and currently enrolls about 70 postgraduate students. The MSc program normally takes two years to finish. The first year consists of course-work which averages 12 lecture hours per week, and the second year is devoted entirely to developing a thesis which reports research results. Several groups of specialization are offered: electronics engineering, electronic circuits, communication engineering, systems and control engineering, computer engineering, microwave engineering, and propagation and antenna engineering. The granting of the PhD degree is based on research leading to a dissertation. However, I was told that the Department has no electronic technicians and only one machinist who is perpetually listless during the day because he works hard on his own after office-hours to make more money. Under these conditions, in addition to a general shortage of equipment, it would be very difficult to conduct experimental research.

The Electronics and Communication Engineering Department has eight Professors, five Assistant Professors, and 14 Lecturers. Normally, a PhD degree is required for the rank of Lecturer and higher. Professor Abdallah A. Mahmoud is the Head of the Department. The salary levels are extremely low. The monthly salary for a Professor is around 150 Egyptian pounds (LE 150, which is about $225 at the current official exchange rate) and LE 70 (about $105) for a Lecturer. A new engineer fresh from college makes only about LE 27 (about $40) a month which is the daily cost of a double room at a Hilton-type hotel in Cairo. Little wonder that nearly everyone tries to make extra money on the side. Faculty members are allowed to carry overloads, either on or off the campus, which can double their salaries. People, like the machinist, will sometimes just sign in and disappear during the day to work on their own. Office hours are normally from 0800 to 1400, but on the day of my visit, the professors and I had to walk down from the top floor of a building at 1340 because the elevatorman had locked up the elevator and gone home.. It is practically impossible to fire a person in Egypt. In a predominantly Moslem country like Egypt, offices open for half-a-day on Thursdays and are closed on Fridays, whereas Saturdays and Sundays are normal working days. A surprising thing is that roughly 20% of the engineering students are female, contrary to the general impression that Moslem women stay home or are hidden behind veils. This percentage holds at both Cairo and Alexandria Universities.

The Electrical Engineering faculty at Alexandria University has nine Professors, nine Assistant Professors, and 22 Lecturers. Excluding those in the preparatory class, the Department has about 1000 undergraduate students evenly divided among the four years. The curriculum is similar to that at Cairo University. A new five-story Electrical Engineering building has been under construction at Alexandria for six years but is still only half-complete. The present structure is a second attempt; the foundation of the first one collapsed because of some undiscovered underground cavities. Alexandria University has the first and only separate Computer Engineering Department in Egypt. That Department is prospering because it gets to keep all the money it collects for computer services rendered to outside agencies and industry.

At the time I was in Alexandria I had an opportunity to meet with Professor I. Elabd who was formerly the Head of the Electrical Engineering Department at Alexandria University and is currently the Chairman of the Electrical Engineering Department at Lebanon's University of Beirut.

Because of the recent upheaval in Beirut, it has not been possible to hold classes in that city, and he was making arrangements to transport his students to Alexandria so they could resume their education in the Fall. This is a complicated operation requiring mutual understanding and close cooperation between two universities and two departments. Elabd indicated that his effort has been successful.

I have made an attempt to assess the research picture at both Cairo and Alexandria. My impression is that few (full) Professors are active in research. This is partly due to their heavy teaching and administrative duties. Having reached the rank of Professor, a senior faculty member no longer has an incentive in the form of promotion or salary raise to work hard; there are other more lucrative side activities. Of course, there are exceptions. Professor Abdel Sameah Mostafa of Alexandria University, for example, has been active in antenna research for many years and is a Fellow of the IEEE. Unfortunately, he was in Japan during my visit. The younger faculty members, mostly Lecturers with a PhD degree, strive to carry on some research under very difficult conditions of poor facilities and meager financial support. Obviously, the remote electromagnetic sensing project under the PL-480 Program mentioned in the beginning of this article will be an effective shot-in-the-arm for research at Cairo.

The purpose of this project is to use electromagnetic signals to sense the possible existence of water, oil, or minerals under the surface of the earth. The two-year effort will include a theoretical analysis of the method of interference fringes in the presence of an inhomogenous earth, and a comparative and feasibility study of the various experimental methods of collecting and interpreting data in the desert. The technical team will consist of Dr. Samir F. Mahmoud as the Principal Investigator, Dr. K.A. Al-Bedweihy, Dr. A.A. Mohsen, and two other engineers. Samir obtained his PhD from the Queen's University (Canada); Al-Bedweihy's PhD was from the University of Toronto and Mohsen's from the University of Manitoba. It is an able, Canadian-educated team. They will be aided by Wait from the US and Professor M.A. El-Said (Cairo University) as Consultants.

Several research projects are also in progress at Alexandria. These include work on microstrip devices, digital network and active circuits. I had some discussions with a Dr. George P. Fiani, who is an Egyptian and a Christian and who chose to work in Egypt in spite of offers from abroad. I was impressed by his knowledge and dedication. A number of faculty members also work at a Science Center which is a UNESCO-supported research organization. The Center was founded five years ago and is still expanding. It currently has about 45 professional people (including six foreign experts) working in four areas: solid-state physics, electronics, analytical chemistry, and applied mathematics. Regrettably I learned of the existence of the Science Center in Alexandria too late to secure an appointment without disturbing the rest of my itinerary and commitments.

My impression of the status of electrical engineering education in Egypt is that a conscientous effort is being made to provide the students with a good education, but the schools are overcrowded, the facilities are poor and the faculty is overloaded. Changes in these areas can only come from enlightened changes in government policies. There is little reason to doubt that an EE student in Egypt can acquire in five years an amount of basic knowledge equal to or more than what a BSc student in US can acquire in four years. However, the latter has the important advantages of being exposed to the use of modern computers and up-to-date laboratory instruments and techniques.

While in Egypt, I could not help having the feeling that many people were preoccupied with ways to earn more money. Wages are so extremely low and the instinct to subsist is strong. There is no unemployment for engineers in Egypt because the government simply assigns them to the various agencies. A government agency may get ten people even if it only needs four. It has to take all of them, and dismissal or lay-off is almost unheard of. At the university level, to find a second job is of more urgency than to immerse oneself for long hours in a laboratory. Research has a low priority in government planning and in people's preference. I believe that outside help such as the PL-480 Program and the UNESCO-supported Science Center will give hope to some dedicated people as well as raise the country's level of competence in science and technology.
(D.K. Cheng)

FLUID DYNAMICS AT POITIERS

Poitiers stands on a promontory above the junction of the Boivre and Clain Rivers in the west-central region of France. The area has been a strategic one in the history of France, with numerous ancient battlegrounds, imperiously holy edifices, and a cast of characters spiced with names like Louis the Pious and Ebles the Bastard. What the French would refer to as "recent" history corresponds to the beginnings of America, and in this bicentennial year, the visitor is often reminded that many French institutions predate our Declaration of Independence. (About 100 km west of Poitiers is the port of La Rochelle--source of the founders of New Rochelle in 1688, and the point of embarkation of La Fayette who, in 1780, conveyed a secret message to General Washington promising six French men-of-war and 6000 troops to augment his forces at Yorktown.) The Université de Poitiers is such an establishment, having been founded in 1431 by Pope Eugene IV.

Today the University is a major center for French higher education, comprising various schools, institutes, and other organizations that span the entire spectrum of fields of learning. Within this academic conglomerate are the Ecole Nationale Supèrieure de Mécanique et D'Aérotechnique (ENSMA) and the Centre D'Etudes Aerodynamiques et Thermiques (CEAT). Although they are located at separate sites, these groups share facilities and people in what appears to be an effective, if complicated, merger of academic and industrial research interests. The focal point of my visit was the CEAT where, under the leadership of Prof. R. Goethals, a staff of some 100 full-time researchers and support personnel are pursuing a wide variety of investigations into problems in fluid mechanics and heat transfer.

One of the familiar laments in French research laboratories (as well as elsewhere in Europe and, for that matter, the US) is the rising costs of maintaining major experimental facilities. Goethals is facing this problem which is aggravated, in his case, by the fact that his funding, which is channeled through the University, does not include allowance for the upkeep of such equipment. A major problem is "making do," and this is evident at CEAT where several large flow devices have been "moth-balled" due to underutilization and an inability to maintain them in an operational status. Despite these fiscal blues, however, there are several projects underway which reflect a concern with up-to-date problems and an involvement with modern-day techniques. The work is distributed within four laboratories: Aerodynamics, Fluid Dynamics, Heat Transfer, and Energetics and Detonation.

The work of the Laboratoire d'Aérodynamique is carried out in two groups. In the first of these, the aerodynamics of compressible fluids is studied both analytically and experimentally, with emphasis on the latter. The group is mainly concerned with supersonic turbulent flows and is currently studying the interaction of shock waves with turbulent wakes and boundary layers. A major work has recently been completed in which the two-dimensional turbulent supersonic wake behind a slender body has been experimentally and theoretically characterized (P. Serou, J-P. Bonnet, and Th. Alziary, "Application d'un modèle de turbulence à l'étude du sillage compressible," 2nd French Mechanics Congress, Toulouse, Sep. 75). A particularly interesting study is that in which shock reflections are controlled or eliminated by boundary layer suction through a porous wall. All of the experimental work in this group is in some way the beneficiary of a separate program to integrate the most modern of flow measurement methods into the work of the lab. This program involves the use of laser-Döppler velocimetry as well as thermal anemometry in the measure of turbulent supersonic flows. Where possible, both methods are used and checked against each other--a capability that is made possible through the use of high-speed data acquisition and signal-processing equipment.

The second group, headed by Tsen Li Fang, is involved in several aspects of research into turbulent jets, wakes, and boundary layers. The work of this group seems to be somewhat more fundamental than that of the first, and is aimed at determining the structural details of turbulent incompressible flows. One such effort is the numerical simulation of turbulence. With a view towards reduction of computer time, several methods have been employed for the solution of the Navier-Stokes equations for plane turbulence, and a fast Fourier transform method has been found to provide considerable

advantage. The scheme has been applied to the problem of flow behind a blunt body started from rest, and the time-developing velocity field is stored for later processing. This is done by several means, one of which results in a truly fascinating color movie of what appears to be (that is, it fits our preconceived notions) turbulence. The comparison of statistical quantities from these numerical experiments shows remarkable agreement with experimental data for turbulent shear flows. There are several descriptions of this work in the literature, the most recent version in English being, "Analysis of time-stationary turbulent signals obtained from numerical simulation," by Tsen and M. Bouriot in the *Proceedings of the 5th Canadian Congress of Applied Mechanics*.

The Laboratoire de Dynamique des Fluides, headed by Professor Janine Peube, is situated in a modern addition to the University campus. Here the work is divided into five groups: acoustic and unsteady phenomena, turbulence, swirling flows, flows with transport, and the newly-formed solar energy group. Peube is personally involved in the work of the first of these groups and she showed me several fascinating experiments designed to investigate the coupling of acoustic disturbances with turbulent flows. In one of these she has established several regimes of flow generation from an acoustically-excited resonance tube. Depending upon the value of a non-dimensional grouping involving the tube geometry, the frequency and amplitude of the acoustic input, and the kinematic viscosity of the working fluid, the flow from the tube can be non-linear (chaotic), pulsating, or possess a noticeable mean velocity with a characteristic turbulent wake emanating from the tube walls (at high acoustic frequencies and/or amplitudes, or small tube diameters and low kinematic viscosities). The acoustic "creating" of a turbulent wake from an initially stationary fluid will, it is hoped, contribute to the understanding of the origin and nature of turbulence. In the work devoted to turbulence *per se*, the main interests are in the laboratory simulation of atmospheric turbulence and in the flow past objects (such as buildings) immersed in a turbulent boundary layer. In the former instance, J. Bernard and others are attempting numerical and wind-tunnel experiments to develop a package of predictive methods that are consistent with available data on free air turbulence.

At ENSMA, in the Laboratoire d'Energetique et de Dêtonique, Professor N. Manson and several students are pursuing various research studies in gaseous detonations. Manson is internationally known for his work in this area, and his group constitutes something of a French center-of-excellence in detonation research.

The laboratory is well equipped for several unusual experiments as well as the standard detonation-wave measurements. In the former category are studies related to gaseous detonations in metal-containing mixtures and the detonation of gases in foams. Tests have recently begun to determine the detonation properties of gaseous fuel-oxidizer mixtures containing particles of metallic aluminum. The apparent motivation for these tests is the expectation that the metallic particles will participate in the detonation process and therefore yield higher impulses from smaller charge volumes. A rig has been built in which aluminum particles are suspended ("fluidized") in a vertical flow of an ethylene oxide/oxygen mixture. The experiment is quite intricate in that careful timing is required between the cessation of the flow and the initiation of the detonation. The current major problem, however, is the determination and control of the distribution of metal particles in the mixture. Preliminary tests indicate only a very small influence of the aluminum particles upon the detonation properties (velocity and impulse). A number of subsidiary tests are also underway to examine the basic ignition and burning behavior of aluminum.

One of Manson's students has developed a technique of creating a foam by bubbling propane through a water solution of common liquid soap. The description of this work was somewhat cursory but did include an impressive demonstration in which a handful of foam was exploded by simply lighting it with a match. No applications were mentioned other than the obvious merits of foam as a means for non-rigid containment of an explosive mixture.

It is probably apparent by now that my visit to Poitiers was less than comprehensive; and this was one of the chief impressions left with me--that there is an awful lot of fluid mechanics going on there. Most of what I saw was on a fairly modest scale in terms of plant equipment,

but I was particularly impressed with the extent of professional people-power being applied to selected problems. Noteworthy among these is turbulence--perhaps the central pacing problem in fluid mechanics today. For those many who currently labor in this field, Poitiers and, in particular, CEAT and ENSMA, should be sources of valuable contributions. (R. H. Nunn)

TRIBOLOGY--TECHNOLOGY OR TAUTOLOGY?

Problems associated with friction and wear probably date back to the days when cave men used to drag their true-loves by the hair over unpolished surfaces. It was not until 10 years ago, however, that it was found to be necessary to lump these problems, and their related disciplines, into what was called a "new industrial technology." The origins of the movement were in the UK where the extent of industrial difficulties due to friction and wear was seen to be sufficient to justify direct government intervention. In 1966 the Department of Education and Science (DES) established a Working Group, under the chairmanship of Dr. H. Peter Jost, to identify the problems further and to advise on methods for their solution. Among many ideas spawned by the DES Working Group was the naming of the game: Tribology (stemming from the Greek *tribos*--to rub).

In celebration of the 10th birthday of Tribology, we have endeavored to discover the motives for its conception, and to examine some of its offspring in order to evaluate the success of the movement and learn from the UK experience. Our report, titled "An Industrial Technology Called Tribology--the UK Experience and Its Implications," is available through the usual channels (see back of this issue). We warn the potential reader, however, that the nature of our quest was such as to lead us down politico-economic paths, and the report reflects the subjectivity inherent in such ventures--it is something other than a listing of current approaches to research in friction and wear.

The DES Working Group chose to illustrate the extent of tribological ills in UK industry in the form of money to be saved by "proper" design and maintenance--some £515 million, about 1.5% of the 1966 GNP. This was somewhat unfortunate, because the unproveable prediction has tended to be used as a measure of proof by supporters of tribology as well as by its detractors. The prognosis of huge financial gains did have something of a shock effect on the government, however, which promptly perpetuated the Working Group in the form of a Committee on Tribology. This Committee produced its final report in 1972, but it continued to exist as a sub-Committee of the UK Committee for Industrial Technologies. More important than the vision of £515 million in potential savings, to us anyway, were some of the causes listed for these deficiencies: the interdisciplinary nature of things tribological, and the inadequacy of communications between researchers (largely academic) and the industrial practitioners who were not deriving sufficient benefits from research.

A central theme of the Committee on Tribology was one of awareness. This is evident in the work of its sub-committees and working groups, the most important of which were concerned with education and training, research and liaison, and information and publicity. Today in the UK, and to some extent throughout the world, there is indeed a noticeable increase in awareness of tribological problems. The energy and dedication of those involved with the activities of the Committee have contributed to an exercise in technological public relations that deserves high marks. In the educational field, a "Basic Tribology Module" has been defined as representing a minimum coverage of tribology which should be present in the education of all mechanical engineers. Ambitious programs of a continuing-education nature have been developed and presented to industrial groups, and a *Tribology Handbook* has been published (M. J. Neale, ed., Butterworths, 1973). These and many other products have been distributed within the UK with a liberal measure of enthusiastic salesmanship.

A particularly significant idea of the DES Working Group, later endorsed by the Committee on Tribology and implemented by the UK government, was to establish "Centres of Tribology." These were seen to be needed as a means of spanning the gap between industry and academia. In the US and elsewhere, the Centre operation might be viewed as an approach to Technology

Transfer. With government underwriting, three Centres were established in 1968: two were sited on University property at Leeds and Swansea, and the third was based within the Reactor Engineering Laboratory of the UK Atomic Energy Authority (UKAEA) at Risley in central England. The Centres were to have cut their governmental purse-strings by the end of their first four-to-five years of existence. Because of the nature of the relationship between the UKAEA and the Centre at Risley, it is difficult to assess the extent of its fiscal independence. With the exception of government contracts for specified projects, however, the Centres at Leeds and Swansea no longer receive government funds.

The Tribology Centres have been major focal points for our study, and their activities are described in our report. In general, the operations are modest, with staffs of 20, 15, and 3 at Risley, Leeds, and Swansea, respectively. Major portions of the activities of the Centres are devoted to trouble-shooting for industry and testing various machinery components for their wear and friction characteristics. Within the Centre at Risley, there is the European Space Tribology Laboratory--a valuable entry by the UK into the European space program. With a few exceptions, mostly at Risley, there is not much in the way of research going on (some projects are underway in nearby university engineering laboratories), and this is in spite of one of their original assignments "...to undertake research on a commercial basis." Also, in spite of their charter, the Centres now work independently of each other and often are in competition for the limited industrial business in tribology. Partly because of these factors, we sense that the Centres have not been completely successful in bridging the gap. On the side of the Centres "facing" academia, there is a need for more in-house research. On the industry side, even after 10 years of hard-sell, there is still a lack of commitment to tribology as a legitimate technology deserving of long-term investment.

In our visits to laboratories outside of the Tribology Centres, such as the one at Imperial College, we have seen a measure of high-quality interdisciplinary research in friction and wear that tends to belie the need for a new government-initiated industrial technology. In fact, we were left with the impression that many of the more successful lubrication and wear programs extant have not been "tribologized."

In our view, the two dominant and bonafide influences that cause people to think in terms of new organizational frameworks such as industrial technologies are (1) the interdisciplinary nature of real-world problems and (2) the persistent communications problems that exist between industry and the largely-academic research activities. That these influences exist today, as they did in 1966, is something of an indictment of the engineering community, and especially its academic underpinnings. We are not convinced that the formulation of tribology-like industrial technologies are nature's way to a solution to these problems.

The key is design, with all the interdisciplinary real-world orientation that the name should imply. Much of the responsibility for the stimulation and advancement of design, with all the "ologies" contained therein, lies with educational institutions and sponsoring agencies. The difficulty of the problem is in proportion to its importance.
(R. H. Nunn and H. Herman)

ENVIRONMENTAL SCIENCES

METEOROLOGY IN ATHENS

There are three Chairs of Meteorology in Greece, and Dr. D. Lalas, on leave from Wayne State University, Detroit has just been appointed to the most senior, the one at the University of Athens. The choice in such an appointment might reflect the University's realization that dynamic meteorology is more than just compiling temperature statistics and that it is a discipline dealing with particular aspects of fluids in motion. Although this appointment points in the right direction, the road to modern meteorology for Greece and for the University of Athens will not be an easy one.

Aside from financial considerations, the main stumbling block might be found in the "Byzantine" atmosphere (i.e., inertia, red tape) which prevails in all transactions at the University. The young staff members that are now beginning to populate the ranks of the Science Faculty at the University of Athens are trying hard to rid the system of its autocracy

and inertia. Most of this young staff, having had their university training in the US, want to liberalize the system and see more authority delegated to the junior faculty. This and other similar liberal moves are being resisted by the older members who see their position as professors (with a chair) as a source of power in the university and the government. They are concerned about the financial implications of such a delegation of authority.

Dynamic meteorology in Greece is practically non-existent: PhD dissertations and research projects in the Department are limited in scope to climatological studies in a specific locality of Greece. Along with the Chair of Meteorology there are positions for two senior assistants and 10 assistants. These younger faculty members, who assist the professor in his task, were trained under the old system. Lalas plans to send a few of them to such places as the Department of Geophysics at Reading University in the UK where they will, in two years time, acquire a basic knowledge of meteorology. This fall, he is planning a new set of courses tailored after those offered at some US universities. A student in meteorology will now be required to take more advanced mathematics than in the past.

Lalas also is attempting to create new job openings for persons with a degree in meteorology. The Ministry of Social Services (Pollution Studies), Agricultural Research, the National Electricity, the Weather Services, Shipping, the Ministry of Manufactures, etc., are all entities which could use graduates in meteorology if their job descriptions called for someone with the needed qualifications. Therefore, one of Lalas' immediate tasks will be to convince the appropriate officials to rewrite some of these job descriptions and qualifications. He hopes to open up about 40 to 50 new positions and feels that these could absorb some of the new graduates in meteorology. Lalas is also the Director of one of the five Institutes that comprise the Athens Observatory. His Institute's main task is to detect and monitor pollution in the city of Athens. The stimulation behind such a study arises from efforts to preserve the stones of the Acropolis and the Pantheon from chemical reactions with atmospheric pollutants.

As far as research goes, Lalas, who has done a sizable amount of research dealing with the propagation of gravity waves in a moist atmosphere, wants to institute work on lee-waves (i.e., atmospheric gravity waves excited by mountains) and sea-breezes in an effort to understand local microclimates or weather situations typical of the mountaineous regions of Greece. He has already approached pilots of Olympic Airways to learn more about these lee waves observed during their flights over Greece, and possibly to install a network which might sense some of these disturbances.

Lalas is approaching this considerable task with enthusiasm and innovation. His experiences may well prove to be of value to others who strive to elevate the excellence of academic programs in countries where dynamic meteorology has not yet taken a foothold.
(A.I. Barcilon)

GENERAL

ARABIAN NAMES AND ARABIC NUMERALS

In a previous article ("The Name Puzzle," ESN 30-5:220), I tried to clarify the puzzle associated with some foreign names whose structure is different from conventional American usage. For people who make courtesy or liaison visits to various foreign lands it is important to know which part of a person's name is the family name in order to address him (her) properly. This often is not as simple as it may be assumed.

Recently I visited several institutions in Egypt and found some interesting variations in the structure of Egyptian (Arabian) names. For one thing, some Arabs do not even have a family name, and it is quite natural for a father and a son to have different last and different middle names. Other Arabs do have a family name. Examples are those whose last names contain the prefix *El* ("The" in English). For instance, Hassan El-Sabbagh, a Professor of Electrical Engineering at the University of Alexandria, can be safely addressed as Professor El-Sabbagh. Besides this particular case, I do not know whether there is a general way to tell if a person's last name is his family name. I imagine that one must first know more about the various Arabian names and the Arabic language in order to be sure.

Most Arabian names have three parts: the first part is the person's given-name; the second part is his father's given-name; and the third part is his grandfather's given-name. My contact at the University of Cairo, Dr. Samir F. Mahmoud, told me that Samir is his given-name, the middle initial F stands for his father's given-name Fahmy, and Mahmoud is his grandfather's given-name. His full name implies Samir bn Fahmy bn Mahmoud, where bn is short for ibn which means "son of." His last name Mahmoud ("praised") is not his family name. In fact, as far as he knows, he does not have a family name. He said that if he wanted to he could tag on his great-grandfather's given-name after Mahmoud. It is then not difficult to understand that he and his father have different last and different middle names. What is more unusual is that he is listed in the telephone directory under Samir, not Mahmoud. When he marries, his wife would be called Mrs. Samir, not Mrs. Mahmoud. However, her name does not formally change after marriage and her maiden name (without either Samir or Mahmoud) continues to appear on all official documents including her passport.

Sometimes a person can have two given-names. For instance, a father may give the names Mohammed Amin and Mohammed Sayed to his two sons since Mohammed is a revered name for Moslems. Hence, the two brothers would have the same first name and the same last name. Both of them would appear in the telephone directory under the name Mohammed. (I imagine the Mohammeds occupy a much larger percentage of the directory pages in Cairo than the Smiths in New York.) In Egypt, as in Spain, it is not wise to assume that a person's last name is his family name or that everybody will be known to his friends by his first name.

In fact, assuming things in an unfamiliar foreign land can lead to erroneous conclusions. I have always admired the beautiful Arabic calligraphy, but the only thing I know about it is that it is written from right to left. However, when I made plans to visit the universities at Cairo and Alexandria, I was "sure" that at least I knew the Arabic numerals and could pay the right amount of money written on the bill at a restaurant or a store. I could not have been more wrong! It turned out that the Arabs in Egypt do not use what we have always accepted as Arabic numerals: 1, 2, 3, ... Instead they use a set of numbers from one to zero which bear no resemblance to the above except the symbols for one and nine. The comparative symbols are as follows:

Hindu-Arabic Numerals

1 2 3 4 5 6 7 8 9 0

Arabic Numerals used in Egypt

١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ٠

Encyclopedias tell us that the earliest numerals of which there is a definite record appeared in Egypt as early as the First Dynasty (around 3000 BC). The widely accepted modern numerals were derived from many sources, in particular, from the Hindus and the Arabians. India is the country which first used these numerals frequently in about the third century BC; hence, the modern numerals should perhaps be more properly called Hindu-Arabic numerals.

Contrary to the right-to-left flow of the written Arabic, the numerals go from left to right. Thus, as one reads a message in Arabic from right to left, he must reverse the direction as he comes to a number. Unreasonable? Perhaps, but who is to tell the people who invented the numerals how to use them? Such is tradition and such is evolution of the symbols for communication. (D.K. Cheng)

A VISIT WITH SIR JAMES LIGHTHILL

It was most pleasing that upon telephoning Prof. Sir James Lighthill at the Department of Applied Mathematics and Theoretical Physics at Cambridge University for an appointment, I was graciously invited to have lunch with him in Trinity College.

Sir James, one of Great Britain's most distinguished applied mathematicians, has progressed through the various stages of development from "Wunderkind" to current holder of the Lucasian Chair of Mathematics at Cambridge University; previous incumbents included Newton, Airy, Babbage, Stokes, Larmor and Dirac. In the process, he was appointed a professor

at the University of Manchester at the age of 26 in 1950 and elected a Fellow of the Royal Society at the age of 29.

We began our meeting with a discussion of turbulence as related to the instability of the laminar flow that gives rise to it. We discussed a classification in terms of flows with inviscid "instabilities," viscid "instabilities," and flows that either exhibit finite amplitude instabilities or no demonstrable conventional instability. The classic flow in a pipe lies in the last category.

We then went on to bio-fluid dynamics, a subject of great current interest to Sir James. In discussing blood flow in the aorta of animals, I asked if the flow always turned out to be laminar and was told that in the larger animals, particularly under stress, the flow could be turbulent during a portion of the heart-beat cycle. With large animals under stress, therefore, a greater portion of the flow cycle would be turbulent. We then discussed the possibility that peristaltic pumping of a fluid in a tube could be looked at from the point of view of pumping action brought about by an induced Reynolds stress.

Some of Lighthill's recent activities include the "Fifth Fluid Science Lecture--Aerodynamic Aspects of Animal Flight" at the Royal Institution on 20 June 1974, sponsored by the British Hydromechanics Research Association; and the John von Neumann Lectures, 1975, entitled "Flagellan Hydrodynamics." In the "Aerodynamic Aspects of Animal Flight" the mechanics of flight of numerous animals from flying marsupials, lizards, and fish through insects, birds and bats were considered including takeoff, landing, hovering, turning and sustained flight; the scholarly aspects of the work are illustrated by the 50-odd references, including work by Rayleigh, Von Karman, Greenewalt and others, that are not only quoted but integrated into the author's contribution. In the "Flagellar Hydrodynamics," the propulsion of microorganisms by single and multi-flagella was discussed. Propulsion by means of a propagating "bend" on a flagellum is caused by the differential drag of a section of the flagellum in axial and transverse flow. The collective action of cilia in causing propulsion (or in moving fluid over mucous linings in larger organisms) was also discussed. Again, the scholarliness of the work is apparent in the integration of the previous work of many researchers into the unified, mathematical treatment.

Sir James has recently authored a book entitled *Mathematical Biofluid Dynamics* which was published by SIAM (Society of Industrial and Applied Mathematics) in 1975 in Philadelphia, PA 19103.

Work that is almost completed, or very well underway includes the following books: (1) *Scale Effects in Animal Locomotion* (Academic Press, publication expected in 1977) concerning terrestrial, aquatic and aerial locomotion. The sponsors are the International Union of Theoretical and Applied Mechanics and the International Union of the Biological Sciences, (2) *Introduction to Scaling of Aerial Locomotion* Proceedings of a Symposium sponsored by the Institute of Mathematics and its Applications in Cambridge (1975), (3) *Fisheries Mathematics* with an article on Fish Locomotion (Academic Press, publication expected in 1977).

There is also a contribution of a chapter "Mathematics in a Physical Environment - Computer Weather Forecasting" (3-day Northern Hemisphere) to a book *Newer Uses of Mathematics* to be published by Penguin Press.

In his "spare" time, Lighthill enjoys swimming, music (he is a pianist), traveling, reading, Russian literature and poetry. He is fascinated by Indian art and music.

Sir James Lighthill is very much more than a mathematician, he is a natural philosopher in the fullest sense and a most broadly developed individual. (M. Lessen)

MATHEMATICS

APPLIED MATHEMATICS AT LEEDS

The Department of Applied Mathematics at Leeds University is large [by US standards] since it numbers about 23 faculty members including three full professors, three senior lecturers, and 17 lecturers. This large lower stratum in the faculty ladder is composed of young members hired during the explosive expansion phase of the mid-60's. The Department is part of the School of Mathematics which also contains the Departments of Pure Mathematics, Statistics, and Computer Science. In the Applied Mathematics Department graduate enrollment is rather low, hovering at

present at six or seven graduate students instead of the twenty or so expected next year. This low figure can be partly explained by the current difficulty in obtaining a job even after one has been granted a PhD. It is interesting to note that graduate students in pure mathematics are about four to five times more numerous than in applied mathematics. One might conjecture that having a PhD in pure mathematics has never been a guarantee for securing a job, therefore, people that pursue these studies do so for their own pleasure and fulfillment. The Applied Mathematics Department is primarily a service department at the undergraduate level since it teaches some 2000 students coming from Engineering, Physics, Chemistry, Economics, and Geography. Lately, undergraduate enrollment has decreased due to government pressures to reduce the number of students in universities.

The research thrust of the Department lies in two broad areas: the dynamics of deformable media with problems in rotating flows, stratified flows, lubrication, ionized gas, waves, aerodynamic noise, and stability; and in mathematical physics (about four faculty members) with problems in statistical mechanics, quantum theory, solid state, and astrophysics. Faculty members working in these areas do not have joint appointments with the Physics Department. Since I spent only one day in the Department, it is impossible to do justice to all the various topics in which research is presently underway. Rather, I talked to people whose problems appeared of special interest to me.

Being interested in vortex flows, I spoke with Drs. D. Ingham and M. Bloor, who are developing a mathematical model for the flow field found in industrial cyclone separators. These devices are truncated cones having a small angle at their apex, a typical axial dimension of some ten ft, and at their wider opening, a diameter of about two ft. Fluid is injected tangentially onto the inner conical wall and removed in the axial direction at the wider opening. The concentration of angular momentum generates a strong vortex having an axial boundary layer and a boundary layer on the inner conical wall. The fluid is a mixture of a fluid phase, generally water or air, in which solid particles are suspended (possibly dust, coal dust, etc.). When subjected to high rotation rates, the particles are centrifuged outwards and are trapped in the wall boundary layer which, presumably, transports the solid residue to the narrow opening of the cone. Thus, in theory, about some 5% of the flow transporting this solid residue is pumped out at the narrow end leaving the remaining 95% of the solid free fluid to be sucked out at the wider end of the cone. In practice, unwanted boundary-layer flows are responsible for transporting solid particles to the wrong outlet. Ingham hopes to have a Postdoctoral Fellow design flow visualization experiments which will help guide the mathematics. He is also interested in biomedical fluid dynamics and is looking at the mathematical modeling of dust deposition in tubes in an effort to understand aerosol deposition in the lungs. The experimental work paralleling the mathematica analysis is being done by Dr. C.N. Davies of Essex University. Unfortunately, Ingham feels that his work will be judged by mathematicians and not by physicians; as a result, he wants to limit his research efforts to more conventional mathematical problems.

Dr. M. Savage is interested in stability problems. Experimental evidence obtained by Dr. F. Mobbs of the Mechanical Engineering Department seems to suggest two new instabilities of the Taylor type. A Taylor vortex is an instability which develops when viscous forces in a rotating fluid can no longer stabilize a distribution of angular momentum which decreases with radius. This is best demonstrated in the laboratory by observing the evolution of a fluid found in the gap between two long, coaxial cylinders where in the outer one is at rest while the inner one is made to rotate. These experiments were first performed some half a century ago by G.I. Taylor, who observed that toroidal cells with more or less square-like cross section developed when a non-dimensional number, now called the Taylor number, reached a critical value. Mobbs appears to have found two instabilities that develop at about one-third and one-half the critical Taylor number. Savage feels that end-effects might modify the basic flow sufficiently to be responsible for these new instabilities, and hopes to develop simple mathematica models capable of predicting these new transitions.

Dr. J. Brindley is concentrating his research on mathematical problems stemming from modeling flows found in the so-called "dish-pan" experiments that simulate some of the large scale

features seen in the atmosphere. He has two graduate students working on non-linear baroclinic stability problems and another extending some of the work of Dr. B. Hoskins on the instability of frontal zones.

Dr. I. Tolstoy has been looking at the propagation of seismic pulses in a solid which is anisotropically pre-stressed. Some of these stresses can be expected to occur in the upper mantle of the earth due to surface-loading and to forces related to continental plate motions. He feels that this theory will reconcile some of the observed discrepancies in the propagation velocities of some of these waves. He has also been working on problems of a more mathematical type. In particular, using canonical transformations, he was able to show that any ordinary non-linear differential equation can, in principle, be transformed into a linear equation or a system of linear equations. This proof is not to be construed as a general practical method for finding such a transformation: it merely shows that it always exists. He also suggests that it may hold true for partial differential equations. His other research interests lie in extending some general theorems regarding orthogonality of modes in moving media and understanding how these properties are modified for dissipative systems. He feels that dissipation could be "absorbed"--so to speak--in a set of fictitious non-physical modes, and the system could then be made conservative. Some of this work should prove valuable when one deals with complex numerical problems for knowledge of orthogonality can be used to construct approximate eigenfunctions. He is also interested in the modification of these properties when a critical layer is present. Such a layer occurs at the level where the phase velocity of the wave equals the velocity of the mean flow.

This large Department seems to have a wide range of research interests. Not only are the various facets of fluid dynamics covered, but the Department also has some of its members carrying out research in areas of theoretical and solid state physics. As is fairly typical of applied mathematics departments in British universities, most of the motivation for this research stems from engineering problems. (A. Barcilon)

OCEAN SCIENCES

CONFERENCE ON BEHAVIOR OF OFF-SHORE STRUCTURES

BOSS '76--an international conference on the behavior of off-shore structures was held at The Norwegian Institute of Technology, Trondheim, the first week in August. It was sponsored by The Delft University of Technology, University of London, MIT, and the host Institute. It was the first in a series of conferences planned to be held every three years, with the next one scheduled in London. About 450 people from 20 countries attended.

The format of the meeting was a combination of plenary and specialty sessions and was effective in giving the participant a chance to listen to papers on his specialty and at another time to hear papers that cut across the field. Plenary sessions were held on the state-of-the-art, interaction, safety and future problems. The specialty sessions were on waves, soils, and structures.

As is usually the case (maybe it's even always) the Norwegians did a superb job of organizing and running the Conference and the related logistics. Everything went like clock-work, and it was obvious that those in charge really cared that the Conference was a technical success and that those attending were looked after.

Professor Jerome H. Milgram (MIT) opened his paper on the state-of-the-art on waves and wave forces by saying that the paper prepared by Hogbern (1974) gave the most detailed comprehensive review available. (Author's note: This paper is entitled "Fluid Loading on Off-Shore Structures. A state-of-the-art appraisal: Wave Loads", Maritime Technology Monograph No. 1, Royal Institution of Naval Architects, 10 Upper Belgrave St, London SW1X 8BQ.)

Among the conclusions reached are the following: wave forces on fixed bodies can generally be predicted either by potential theory or by model tests if the distance that the fluid particles move between reversals of flow direction in the waves is not significantly larger than the cross-sectional dimensions of the body. This range of validity includes essentially all total wave forces for very large offshore structures, but does not include the forces

on smaller structures such as marine risers.

When the distance that fluid particles move between flow direction reversals is significantly larger than the cross-sectional dimensions of the body, we cannot accurately predict the wave forces in general. The effect of shed vorticity invalidates potential theory, and the inability to attain full-scale values of the Reynolds number usually invalidates the model tests. Furthermore, except for especially short waves, many model test tanks cannot generate waves large enough to attain full-scale values of the period parameter, K, for the case of large waves.

Dr. Kaare Høeg (Director of the Norwegian Geotechnical Institute, Oslo) gave the state-of-the-art paper on "Foundation Engineering for fixed Off-Shore Structures." He stated that his paper was to be considered an updating of the earlier reports by Bjerrum (1973) and Eide (1974), (L. Bjerrum "Geotechnical problems involved in foundations of structures in the North Sea", Norwegian Geotechnical Institute Publication 100; and O. Eide, "Marine Soil Mechanics: Application to the North Sea Structures," published as Norwegian Geotechnical Institute Publication 103.) He went on to say that significant advances have been made in the last couple of years, and the experience and data from the installation and performance of fixed platforms in the North Sea are now available and being analyzed.

Some of the points made in his presentation are: new field equipment has been designed which makes it possible to perform deep cone-penetration tests and to take higher quality soil samples than have been possible thus far.

Based on small laboratory samples, it is extremely difficult to predict field deformation and strength properties of stiff overconsolidated clays. Research projects involving field plate load tests with cyclic vertical and horizontal loads are under way.

Great care must be exercised if results from cyclic loading of small laboratory samples of sand are to be used to predict the magnitude of pore water pressure build-up in the field. Sample preparation and boundary conditions have significant effects on the measured porewater pressures. Indications are that results from tests on reconstituted elements in the laboratory give much higher pore pressures in most cases than those that will build up in the field. However, even in the very dense sands under the base of the Ekofisk tank, positive excess pore pressures developed during storm loading.

Improved methods for foundation deformation analyses during storm loading are required. Finite element analyses with realistic constitutive relationships for the cyclic behavior of the soil should be performed to provide the equivalent spring constants for use in the dynamic non-linear soil-platform interaction analysis. Recently developed model-testing techniques with large block samples of soil will greatly assist in developing reliable computational procedures.

Dr. E.M.Q. Røren (Det Norske Veritas, Oslo) discussed the state-of-the-art in structures and structural design. While he gave a broad review, he also indicated the position of DNV, the Norwegian Certifying Society (see ESN 30-1:6) on some of the outstanding questions of the day. He reported that DNV would require that a semi-probabilistic (limit state) method of design be used in the design of both steel and concrete structures. He put particular emphasis on fatigue, citing the well-known shortcomings of Miner's rule. He suggested that the approved proposal by Erismann in *Engineering Fracture Mechanics* Vol. 8, 1976 is more suitable for engineering design purposes. Here both the crack length and the residual strength of the member are considered. He concluded on fatigue by saying that two criteria may be considered for fatigue design: safe life or fail-safe design.

Dr. -Ing. Longrée (Ingenieurgemeinschaft Meerestechnik & Seebau GmbH Hamburg) reported that the West Germans have installed a research platform called NORDSEE in their section of the North Sea. It was designed to serve the same general functions as the British tower at Christchurch Bay but whereas the British tower is to provide soil-structure-wave interaction data, NORDSEE, in addition. has extensive laboratory facilities that support meteorological and oceanographic experiments.

The structure is a hybrid, having a concrete base and tubular steel superstructure, and is heavily instrumented to provide data on the following: stress in the tubular sections, "hot-spot" stress at nodes, structural vibration, bearing loads on foundations, and wave loads. Pore-pressure gauges are in the soil.

With the two research platforms,

one at Christchurch Bay and NORDSEE, and the extensive instrumentation on the working platforms, the Europeans are starting to get an enormous amount of information on soil-structure-wave interaction as well as on installation loads and shake-down effects, if only a reasonable percentage of the instrumentation continues to work.

The three specialties were brought to a focus at the session on interaction, which was "chaired" by Prof. W.T. Lambe (MIT). He gave an excellent introduction to the papers by talking about what must be one of his favorite subjects--prediction. After saying that prediction is the essence of engineering, he went on to show some examples of bad predictions. He said that there were three kinds of predictions: Class A, made before the event, B made during, and C made after. The reason I'm making a point of this is that this classification caught-on, and before long all speakers were classifying their predictions (it usually turned out that they made class A predictions and others made B and C types).

In this session as well as the one on safety, the speakers discussed the uncertainties in the loads, the materials, the structures and the soils and how to arrive at an "acceptable" solution to these combined problems. Of course, one is led to ask what is an "acceptable" solution. Dr. G.G. Myerhot, (Nova Scotia Technical College, Halifax, NS, Canada) in a provocative paper entitled "Concepts of Safety in Foundation Engineering Ashore and Offshore" reminded the audience (though they didn't need to be told) that we were discussing safety against the backdrop of three earth-dam failures in recent weeks (Teton Dam in the US, one in Norway, and one in Germany). He suggested that the risk of failure of an off-shore structure was greater than the risk of failure of an earth-filled dam, which he judged acceptable in view of the restricted use and occupancy of the former and its short economic life. His suggestion that attracted most interest, I think, was the idea of designing with a factor of safety that decreases with time so that the structure collapses at the end of its economic life.

What of the future? Just as the discovery of oil in the North Sea was the stimulus that produced new designs to cope with the new conditions there, by 1978 12 concrete gravity structures will be in place in water 100 to 150 m deep--so will the requirements for new designs be set by the conditions at the new sites? The R&D attention of many organizations is now concerned with the problems of working in deeper water and in ice. The next set of structures, already in the preliminary design and model-testing stage, are guyed towers and buoyant structures anchored to the bottom by cables under tension at all times. Going hand in hand with these approaches will be the production of oil on the sea floor.

It was a first class Conference; the papers were good and to the point. It was exciting to see the engineering design process working. Starting with a statistical distribution of waves, the designers work through to a prediction of the likelihood of failure as a function of time and then check to determine if it is an acceptable economic and social risk--real engineering. Corrosion and fatigue are still the two big uncertainties and a great deal of research work is going on in order to reduce the uncertainty.

An Englishman said that there has been nothing to compare with this engineering effort in Britain since the building of the railroads.
(J. P. Walsh)

JIM, A JOINTLY DEVELOPED ARMORED DIVING SUIT

Armored diving suits (ADS) have been built since the 18th century. They have had varying degrees of success although little documentation is available on the early suits. During the 1940's there seemed to be a decline in the development of the ADS which can be attributed to the invention of scuba plus the fact that there was no continuing need for underwater work at depths greater than those which could be achieved using standard diving equipment. The tremendous expansion in the recovery of fossil fuels from the sea and the increasing depths at which divers are working has rekindled interest in the one-atmosphere ADS.

Before going further perhaps we should explain what a one-atmosphere ADS is. Basically it is a pressure vessel with articulated arms and legs, the limbs being neutrally buoyant so that operator effort is required only to overcome the friction within the articulated joints. A drawing, taken

from a recent uncopyrighted advertising brochure, shown in the accompanying figure schematically represents a suit referred to as JIM, recently developed by the DHB Construction Ltd., Alton, UK in conjunction with a parent organization Underwater & Marine Equipment Ltd., (UMEL), Farnborough, UK.

The life support system for JIM consists of two independent systems which are designed to maintain a constant PO_2 inside the suit. An oral-nasal mask--shown in the figure--is used for breathing. When the suit is sealed, the atmospheric pressure inside is equivalent to that at the surface. Oxygen is provided through a redundant system from a dual set of cylinders contained in a backpack, and the exhaled CO_2 is absorbed by soda-lime contained in a cannister. The oxygen makeup system is automatic so that the internal pressure is always maintained at one atmosphere.

Because of the requirement for diving deeper, DHB was formed in July 1969 to re-examine the problems experienced with previous armored suits, to design a new suit, and in collaboration with the National Research Development Corporation, to produce prototypes with a design working-depth of at least 1000 ft.

As a result of a chance meeting in a pub, the developers subsequently learned of an ADS developed in the UK in 1930 by J.H. Peress (a Persian immigrant). This suit, of which only one was built and stored in the attic, served as a basis for the development of the new advanced ADS the first of which was completed 6 November 1971. The new suit was named JIM-2 after one of the developers, and the earlier one was retroactively named JIM-1.

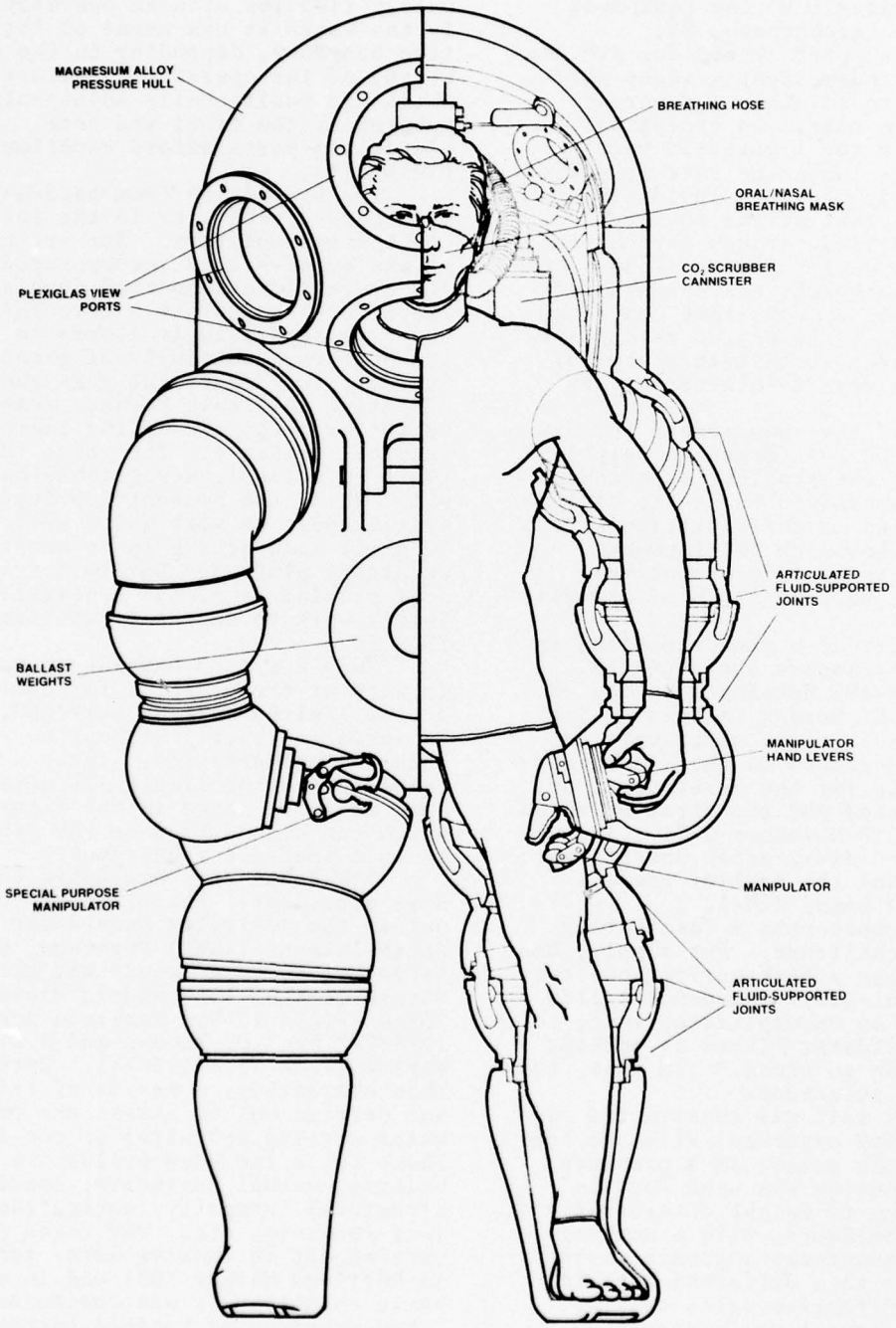
The ADS represents a fascinating engineering challenge. Put simply, one wants to design a high-performance system, with fool-proof independent life support, yet so uncomplicated that, to quote the builders, "There is nothing fancy that can go wrong." In this, they have largely succeeded.

The early suit was constructed of magnesium alloy castings, with the body and hinged dome acting as a pressure vessel. Magnesium was used for the early suit due to weight considerations. The present builders, with a nothing-succeeds-like-success approach chose not to change to a different material for JIM-2. Effective paint coating preparations have largely prevented corrosion problems. The pressure hull, which incorporates two sections with the dome hinged at the front, has received Lloyd's classification for a 1500 ft working depth. The overall height is 6 ft 6 in and its empty weight is 910 lbs in air and approximately 1100 lbs with an operator. In the water it has about 60 lbs negative buoyancy, depending on the exact weight of the operator. Ballast weights, which are positionally adjustable, are mounted at the front and rear. The plexiglass ports afford excellent visibility.

The transition from hard-hat to hard-body diving lies in the joints and the manipulators. The articulated joints successfully incorporated into JIM-2 are fluid-supported double O-rings working against a circular section. They are surprisingly simple in form and perform beautifully at great depths. In fact, the deeper one goes the more effective the seals become, seating better with the aid of the increased external pressure. The joint lubricating fluid is *Castrol*, a vegetable-based oil. While the present lubricating system seems to work quite well, there is still some debate as to anodizing *vs* nickel plating. But this tribological problem is almost a detail; the joints work to depths of at least 1500 ft.

Such a system enables an operator to work at these depths for hours at a time limited only by workload, and to surface directly without having to undergo decompression. Tasks are accomplished using simple manipulators, such as those shown in the figure, which can be modified on the job site to suit specific requirements.

JIM-2 has been evaluated on several occasions. The first was carried out at the Admiralty Underwater Weapons Establishment (AUWE) Portland, UK and is described in a report entitled "Assessment of Atmospheric Diving Suits--Field 17 B.3 Research Report 1973/74" by I.D. Thomas and R.L. Varlow (Tech Note 512/74). During this evaluation, a series of trials was carried out to assess the underwater working potential of the suit. These tests included evaluation of walking, manual dexterity, handling, structural integrity, navigation, object recovery, etc. The tests were carried out in shallow water tanks, in Portland Harbor (UK) and in a hyperbaric chamber. It was concluded that "when operated by trained personnel, the atmospheric diving suit is



ARMORED DIVING SUIT--JIM-2

capable of adequate mobility and dexterity to undertake a range of underwater tasks. It has been shown that the effect of pressure on the articulated joint design at depths down to 1000 feet does not appear to produce any serious degradation in performance at depth."

The second evaluation of JIM was carried out by the Royal Naval Physiological Laboratory (RNPL) Alverstoke, in 1975. The primary objectives of this evaluation were to develop suitable learning tasks for operator training and to assess operator learning time for using the suit. Tasks that were carried out included walking, tightening nuts and bolts, and the use of shackles and lifting hooks.

Based on data obtained from two divers it was concluded that tasks similar to those just mentioned could be efficiently carried out by an operator following a training program involving about 10-20 dives of approximately 40 minutes duration. A second series of trials, also conducted by RNPL, tested the ability of two skilled ADS operators to walk using JIM in currents ranging up to one knot. These tests were performed in a ship-tank where current conditions could be accurately controlled. Their performance was compared, under the same conditions, with that achieved while wearing conventional deep-sea diving equipment. The results showed that the ADS operator could walk at a rate of 50 ft/min in still water and could walk into currents of approximately 1 knot. By comparison experienced divers wearing standard diving equipment were able to walk in still water at 80 ft/min and could walk into a 1.5 knot current. According to the RNPL Report No. 6-74 by A.B. Gisborne *et al*, "As these trials took place in shallow water it appears that the ADS would start to out-perform the standard air diver (due to increased breathing effort and hose drag) in water deeper than 150 feet."

In July 1975 the US Navy Experimental Diving Unit (EDU) in Panama City, Florida performed a preliminary evaluation of JIM. It was concluded that JIM would be a suitable underwater tool under limited conditions." Concern has been expressed by the US Navy that because JIM is unheated the diver might experience cold stress when working in cold water. Recent experience has indicated that this does not seem to be a problem, as the heat generated by the operator during work not only keeps him warm in cold water but produces perspiration.

In addition to these several formal evaluations, JIM has been used in actual open-sea jobs involving the recovery of anchor chains in the North Sea at depths up to 375 ft in 1974, and later for making hydraulic connections in the Canadian Arctic at depths to 915 ft. These working dives are reported in detail in *Ocean Industry* (April and May 1976 issues,) respectively.

The next generation of the ADS is referred to as SAM and currently is under development by DHB Construction Ltd. It is incorporating a number of changes both in materials and construction which should make the ADS much more flexible and considerably less bulky. The single ball-and-socket joint of the JIM suit has been replaced by a series of four curved pistons within the same number of curved cylinders. The effect of several sections within one joint is to give far greater capacity for movement, each section contributing some angular bend, with the net effect being an easier-to-manipulate small cross-sectional joint. In addition an ankle joint is planned which presumably will increase mobility.

SAM and family will be made of aluminum casings, and with the higher strength achieved with this material, it will be possible to produce a significantly less bulky suit. Additional designs are underway, and it is clear that within the practical constraints of simplicity and safety the builders are prepared to consider more state-of-the-art materials and sealing systems such as Fiberglas suits and even perhaps other more interesting lightweight, high strength composites. While visiting UMEL, for example, we saw a partial prototype made of Fiberglas which may actually enable the operator to swim while wearing it.

Development is proceeding slowly due to funding constraints and the sometimes reluctant endorsement of some in the diving community who may see such a development as a threat to existing investments in diving medicine and technology. While operators wearing armored diving suits certainly could replace ambient-pressure divers for certain jobs, the development of such technology should be viewed as an additional tool to be used when needed, not as an all-encompassing panacea for diving problems. As pointed out in the AUWE report referred to earlier, "It is considered that this development (ADS) is complementary to existing methods of underwater working such as

free diving or submersibles and the choice of which particular method to choose will depend, as at present, on factors such as cost and availability."

Both writers have had the opportunity to visit the DHB facilities in Alton where the ADS is fabricated and tested in a small 8-ft deep tank and the facilities of UMEL where the design of advanced suits is underway. One writer (JWM) has used the suit in the tank on six occasions for a total of about three hours water time. On the first attempt to use the suit underwater, it definitely was hard work and one felt extremely clumsy. It is essential, however, to give it a second whirl as there is a drastic improvement both in confidence and performance the next time around. The first point to strike home is the realization that one must move very slowly and take about one step per second rather than attempting to walk at anything approaching normal speed. General maneuverability improves rapidly with practice as well as the feeling of being at ease. The other writer (HH), being basically a land-lubber, restricted his activity to getting into the suit and closing the dome. Even this first step gives one a feeling of appreciation for the system that cannot be obtained by just looking at it. The writers hope to see the development of the ADS continue as it would seem to be an important addition to our diving armamentarium. (J.W. Miller and H. Herman)

PHYSICS

A NEW POSSIBILITY FOR A BLUE-GREEN LASER: THE CdHg EXCIMER

One of the most important recent developments in lasers has been the use of short-lived or quasi-molecules to achieve high-efficiency laser action at short wavelengths. The class of quasi-molecules commonly used for lasers is excited diatomic molecules with unstable ground states, usually called "excimers," an abbreviation of excited dimers. Fluorescence from excimers has been studied for decades, and even though Houtermans indicated their potential advantages for lasers in 1960 [F.G. Houtermans, *Helv. Phys. Acta* 33, 933 (1960)], they did not receive widespread attention by the laser community until 1972. Since then, when laser action was first achieved for the excimer Xe_2 at 1700 Å, many other excimer lasers have operated.

The present interest in excimer lasers stems from their high efficiency and high peak power in the ultraviolet, a difficult act for other lasers. To meet present-day laser requirements in fusion and other applications, it would also be advantageous to have an efficient, high-power laser in the visible region of the spectrum. A desirable laser system would be 10% efficient and able to amplify sub-nanosecond pulses up to energies of 1 kJ. For the efficient extraction of stored energy in a sub-nanosecond pulse, it would be beneficial to employ the homogeneous bound-free continua of excimer species. This is compatible with high efficiency because the upper theoretical limit may exceed 50% when the branching ratios of formation are favorable and the excitation is by an electron-beam sustained discharge.

Malcolm McGeoch and Georges Fournier of Imperial College, London, have recently explored the cadmium-mercury excimer as a possible laser at 4700 Å. CdHg is a member of the mercury-alkaline earth class of excimers (ZnHg, MgHg, etc.) which has not been investigated until now. McGeoch reported on the "Kinetics of the Proposed CdHg Excimer Laser" at the IXth International Conference on Quantum Electronics in Amsterdam on 14-18 June 1976. Their work constitutes the first observation of this excimer, and they reported gain measurements on the 4700 Å continuum band of CdHg. Most interesting was their projected tunable output range of 4500-5500 Å and "wall-plug" efficiency of 5%. This success was predicted ten months earlier in two short theoretical papers given by McGeoch and Fournier at the UK's Second National Quantum Electronics Conference (see ESN 30-1:44).

Currently, the CdHg project is an extracurricular activity at Imperial College, borrowing on the facilities of the Applied Optics Section (headed by Prof. Dan Bradley) and the Plasma Physics Section (headed by Prof. Malcolm Haines)of the Physics Department. McGeoch has been working under Bradley as a post-doctoral research associate, while Fournier is just finishing his PhD dissertation under Haines.

Their experiments were designed around the existing diagnostic tools in Bradley's group, such as his

"tour-de-force" laser: a frequency-doubled resonantly-tuned dye laser pumped by the second harmonic of a Nd: glass laser. Although using such a laser is admittedly a "sledgehammer to crack a peanut" for their purposes, McGeoch and Paul Ewart (another worker in Bradley's lab) obtained the necessary spectroscopic data to confirm the presence and properties of the CdHg excimer. Using 3261 Å to excite CdHg, they studied the emission bands centered at 4700 Å and measured the decay, quenching and mixing rates. Under proper vapor-fill conditions, the excimer fluorescence is quite bright and can be easily observed by the eye. The method of excimer formation which appears to be most efficient is the discharge excitation of the Cd 5^3P levels in a mixture of Cd and Hg vapors, where the Hg concentration is chosen to exceed the Cd concentration in order that CdHg should form rather than the excimer Cd_2. From the spectroscopy they showed that the ground state of the excimer is sufficiently repulsive to allow population inversion up to high gas temperature and density.

The gain experiment was carried out in another of Bradley's laboratories. Using a CW Ar-ion laser as probe, they observed 4% gain/10 cm at 4860 Å. This result was obtained after overcoming experimental difficulties (such as violent shock waves) that arose when large Hg-vapor densities and pump light below 3000 Å were used. In these preliminary measurements, the vapor density of Hg was 2×10^{18} cm^{-3} and the Cd vapor density was 3×10^{15} cm^{-3}. Another gain experiment is being designed by McGeoch using electrical rather than optical excitation. No oscillator experiments are being planned yet.

Some of the useful characteristics of CdHg may be illustrated by a comparison with the most efficient existing excimer laser, KrF. CdHg would be more suitable than KrF for the amplification of sub-nanosecond pulses to high energy because of its lower stimulated emission cross-section of 2×10^{-19} cm^2 compared to the KrF 2490 Å band cross-section of 5×10^{-17} cm^2. At a stored energy density of 10 J/liter, the gain coefficient in CdHg is 0.005 cm^{-1} compared with 0.6 cm^{-1} in KrF. This reduction allows the use of large transverse apertures without parasitic oscillation and yet enables efficient energy extraction at saturation energies of 1 J/cm^2. The theoretical efficiency of excitation of KrF is also high, but the range of parameters giving a stable discharge is very restricted and either high electron density or high Kr metastable density may lead to stepwise ionization followed by arcing. By contrast, the Cd resonance level lies below 4 eV but the Cd atom has a 9 eV ionization energy, so that McGeoch and Fournier have found very small rates of stepwise ionization and expect the easy attainment of stable discharge conditions. Experimentally they have shown that quenching processes are negligible at energy densities up to 20 J/liter.

In spite of the success of these young workers, it was somewhat surprising to learn that their project is not being funded and, in fact, might not have a home soon. Because Bradley feels overextended in his current research effort at Imperial College, this CdHg study will not be included in his program. Since the idea of the CdHg laser originated with McGeoch and Fournier, both Bradley and Haines are willing to let them continue their CdHg research elsewhere. Rumor has it that they will go to Cambridge.

A full technical discussion of this CdHg laser will be given in a forthcoming ONRL Technical Report, "Research Towards a Blue-Green Laser in Europe." This report will also discuss other projects besides the one reported here. (L.G. DeShazer)

EUROPEAN WHO'S WHO IN QUANTUM ELECTRONICS

A new and very useful paperback *European Who's Who in Quantum Electronics* was published by the European Physical Society (EPS) in May 1976. This book was compiled by EPS's Quantum Electronics Division under the guidance of its chairman Prof. Fritz P. Schäfer (Max Planck Institut für Biophys. Chemie, Göttingen). The *Who's Who* is a tremendous piece of work containing information on 132 groups working in 17 European countries. As stated in its foreword, the compendium's purpose is to help scientists become acquainted with each other and to promote contact between the many European groups working in quantum electronics. Not only should the book accomplish this goal, but American scientists should be equally well served by it.

This is in fact the second edition, the first and somewhat incomplete

edition having been published in April 1975. Prof. Stuart Ramsden (Univ. of Hull, UK), a former chairman of the Quantum Electronics Division, initiated the book while another previous chairman, Prof. Klaus P. Meyer (Bern), financed part of its first printing. This is an ambitious project for such a professional group and, despite several difficulties, they have produced excellent results. Depending entirely on responses from individual groups, they found that because of delays the early contributions were no longer up-to-date and others were lacking. There were no responses at all from France for the first edition, and while 24 French research groups are listed in the recent edition, the quantum electronics listing for that country is still incomplete. Among the missing French laser laboratories are the well-known Centre d'Etudes de Limeil (Limeil), Thomson-CSF (Orsay), and Centre National d'Etudes des Télécommunications, (Bagneux and Lannion). Even the French Member of the Board of EPS's Quantum Electronics Division, Prof. G. Mayer of Université de Paris VI, is not listed. Nevertheless, the *Who's Who* evoked a sizable response from the quantum electronics community, and is valuable in that it is the only known compendium on European quantum electronics research. In regard to completeness, Schäfer states that while the second edition leaves much to be desired, subsequent editions are planned for every two years, hoping that they will asymptotically approach completeness.

In the *Who's Who*, each research organization is listed by its name, address, telephone number, personnel (names of group leader and senior staff with total number of personnel), a brief abstract of its research program and a list of recent publications. The included countries, along with the number of listed groups in parentheses, are Austria (1), Czechoslovakia (1), Finland (2), France (24), West Germany (27), East Germany (1), Hungary (2), Israel (7), Italy (16), Netherlands (7), Norway (1), Poland (2), Sweden (2), Switzerland (9), Turkey (1), United Kingdom (28) and Yugoslavia (1).

An example of a brief entry is:

1. University of Uppsala, Institute of Physics, Box 530, S-751 21 Uppsala, Sweden (Tel. 018/139460)
2. Group Leader: Prof. Carl Nordling Senior Staff: Dr. R. Hallin, Dr. J. Lindskog, Dr. A. Marelius Total Personnel: 10 (6 Staff, 4 research students)
3. Research Program: a. Laser spectroscopy of ion beams (lifetime measurements and quantum beats) b. Two-photon spectroscopy
4. Publications a. A. Arnesen, A. Bengtsson, R. Hallin, S. Kendla, T. Noreland and R. Lidholdt, "Lifetime Measurements of BaII $6p^2P_{3/2}$ and $6p^2P_{1/2}$ levels with the beam-laser method," *Phys. Letters* 53A,459 (1975)," et cetera.

Most entries are slightly longer while one from Hungary occupies nine pages of the 276-page book. The contents are listed according to city and country while the group leaders are alphabetically indexed at the end.

This *Who's Who* can be ordered by an International Money Order for 15.00 Deutsche Marks (about $6.00) made to the account of Prof. F.P. Schäfer (Quantum Electronics Division), Kreissparkasse, Göttingen No. 118-006-064, Federal Republic of Germany sent to the address: Prof. Dr. F.P. Schäfer, Max Planck Institut für Biophysikalische Chemie, Abteilung Laserphysik, D-3400 Göttingen, Germany. Industrial or commercial organizations can order a copy for DM500.00 (about $200). The book was on sale at Amsterdam's IXth International Quantum Electronics Conference in June, receiving its first real international publicity. (L.G.DeShazer)

HIGH POWER LASERS AT AWRE

Since last autumn, much press has been given to the British Science Research Council's decision to build a High Power Laser Facility (see ESN 29-12:530). This Facility at Rutherford Laboratory (Didcot, Oxfordshire) will be keyed to the "Cyclops" design of a Nd:glass laser developed by Lawrence Livermore Laboratory (LLL) at Livermore, California. However, another high power laser facility is being developed a short 25 miles from the Rutherford Laboratory within one of the British government's own laboratories, the Atomic Weapons Research Establishment (AWRE).

AWRE is located at Aldermaston, a former WWII "Flying Fortress" airbase near Reading. In 1973 AWRE became a Ministry of Defence Laboratory,

whereas prior to that time it had been under the UK Atomic Energy Authority. As one might expect from its background, the laboratory still retains a heavy emphasis on nuclear technology, but it has also expanded into research in the high energy laser field. Both CO_2 and Nd:glass high power laser systems are being developed and used within the Chief Physics Applied (CPA) Branch of AWRE. CPA's laser program has two parts: "Laser Fusion" under the Superintendency of Fusion and Optics (SFO) and "Laser Damage and Propagation" under the Superintendency of Radiation Effects (SRE).

Although the program name, "Laser Fusion," implies that its work would be directed at laser-induced fusion processes, the current research is on the basic physics of the interaction of laser beams with materials. Patrick Flynn directs SFO, which consists of the groups "Interaction Experiments" headed by Brian Thomas, "Neodymium Glass Laser" headed by N.R. McCormick, and "CO_2 Lasers" headed by David J. Hunt.

The prime emphasis within SFO is the development of a high power Nd:glass laser for studying target interactions. The authors believe that this laser is the only high power Nd:glass laser operating in a UK government laboratory. AWRE's five-amplifier laser system is currently capable of producing 50 GW, 1 nsec pulses. This laser basically follows the LLL plan, but with particular attention being paid to the optical switching. The 1 nsec pulse driving the amplifier chain is sliced out of a much longer pulse from a Q-switched Nd:glass oscillator by a Pockels-cell shutter. Further, the first four amplifier stages are isolated by a combination of calcite-wedge polarizers and Pockels cells, where the shutters open just before the laser pulse arrives and close just after it has passed. These cells are switched using a single laser-triggered spark gap having five channels.

This master spark-gap switch was developed by C.L.M. Ireland and is capable of switching up to 10 kV in five channels simultaneously. When operated close to self-breakdown and under nitrogen at a pressure of 9 kTorr, the gap has a risetime less than 300 psec (details are published in *J. Phys. E*8, 1007 (1975)). The first of these channels operates a Pockels cell used in switching the nanosecond pulse out of the Q-switched pulse, while the other four channels operate the Pockels cells providing isolation.

The CO_2 laser work is concentrated on an experiment to measure the thermal conductivity of a plasma by means of optical scattering techniques. The CO_2 TEA laser oscillator-amplifier system is capable of delivering 10 J in 75 nsec. The laser is used to heat the plasma, and a ruby laser probes its thermal conductivity. This work is being performed in conjunction with Joseph D. Kilkenny (Imperial College, London).

High energy CW CO_2 laser-target interaction is being studied under the "Laser Damage and Propagation" program within the SRE section directed by John Towle. AWRE has purchased an AVCO HPL10 CW CO_2 laser system rated at 10 kW. They feel that it can be pushed to 15 or more kilowatts, making it "the highest power CW source presently available in the United Kingdom." AWRE is planning to use this system, nicknamed ETHEL (Effects Testing High Energy Laser), for laser damage studies. Such topics as thermal coupling, plasma formation, and laser supported detonation and combustion will be investigated. The present plans are to look at simple metal and dielectric targets. On the day of our visit, Nigel Fenner and Colin Allingham were working on laser-supported combustion of titanium. This system has been installed only for a half year, and the work being performed is still in the check-out phase.

The other laser project within the SRE section is the study headed by Peter Stroud on high-energy CO_2 laser pulse propagation. AWRE is currently receiving from the Services Electronics Research Laboratory (SERL) (see ESN 30-5:223) a pair of 500 J, single-pulse, electron-beam-pumped CO_2 lasers for the single-pulse propagation experiments. These lasers can produce pulses with durations in the range of 10 to 70 μsec. The lasers will be used initially for single-pulsed experiments, but double-pulsed experiments with pulse-separation times from 1 μsec to 1 sec are anticipated for the future. The 10.6-μm beam from the SERL laser is propagated along a folded path and focused to a point between two 5-m gas cells. The first cell reached by the beam is the absorption cell containing 1 Torr of propane mixed with nitrogen at atmospheric pressure. The propane simulates the atmospheric absorption caused by water vapor, whose pressure is experimentally more difficult to control. The cell after the focus does not absorb

the beam as it contains pure nitrogen. In order to avoid laser damage to cell windows, the two cells are separated by a fast-acting mechanical valve which opens a 3-mm pinhole only when the laser pulse passes through the cells. It is not expected that much gas mixing will take place between the two cells when the valve is open. After the beam traverses the second cell, it is reflected by a grating into a bank of detectors.

The detection system used is quite new. It is an array of thin-film molybdenum detectors made at AWRE, and evidently works on the photovoltaic effect. They have a maximum input power of 10^5 to 10^6 W/cm^2 and are linear over 3 to 4 orders of magnitude. Currently they are made in strip arrays for ease of access and are approximately 0.5 mm in width. It is expected that detector widths of 0.1 mm could be obtained and that the element-to-element reproducibility is 2 to 3% if all elements are put down simultaneously.

Plans for this propagation facility after the single-pulse experiments are completed include double-pulse studies using the present SERL laser and multi-pulse experiments. The multi-pulse experiments are expected to yield only small perturbations on the CW results, but this hypothesis must be checked. Once the single- and multi-pulse code validation is completed, they anticipate conducting propagation studies in aerosols.
(L.G. De Shazer and MAJ J.H. Gorrell, Jr., EOARD)

NUCLEAR ORIENTATION STUDY CONFERENCE

St. Edmund Hall is one of the oldest colleges in Oxford, having been founded in 1270. It has several significant points of interest such as an early window by Burne-Jones. And St. Edmund was the site of the European Study Conference on Low Temperature Nuclear Orientation in mid-July. About 60 attended the meeting, the first of its kind, which was arranged by Professor N. Stone of the Clarendon Laboratory. The Conference schedule was very suitable for intensive private and small group discussion between the participants, who came from 11 countries and represented about a dozen of the 15-18 international groups interested in this subject. Each day had three one-and-a-half hour sessions leaving both the afternoon and late evening free. Each session chairman gave a one hour summary of a subtopic, bringing up the current points of discussion and introducing subsidiary speakers.

Over half of the Conference was devoted to technique. This was appropriate because the Leuven Hyperfine interactions Conference last fall, which was recounted in ONRL-C-24-75 and in *Hyperfine Interactions* (Editors B.I. Deutch and H. De Waard, North-Holland, Amsterdam), provided a recent review of the scientific state of most of this subject. The participants were all very open with their "tricks of the trade," and the discussion was quite informative.

A detailed report of this conference, emphasizing the technical side of the subject, has been prepared and is available as ONRL-C-24-76. Here I will only mention the session chairmen and the subtopics for which they were responsible and a few highlights.

Dr. G. Eska (Zentralinstitut für Tieftemperaturforschung, Garching) began with a discussion of adiabatic demagnetization. He reviewed the cooling power and thermal contact problems with the dilute paramagnetic salts and the enhanced-nuclear-spin Pr intermetallic compounds, especially $PrNi_5$ and $PrCu_6$. Most of the groups are using temperatures below 20 mK routinely, several have the capability of cooling sources below 5 mK, and a couple below 1 mK. J. Saunders reported on the apparatus at the University of Sussex which demagnetizes 4 moles of Cu nuclei from 13-15 mK in 8 T to reach temperatures well below 1 mK and incorporates ^{60}Co nuclear orientation (NO) and Pt nuclear magnetic resonance (NMR) thermometers. Dr. W. Steyert (Los Alamos Scientific Laboratory) has demagnetized In nuclei below a mK from 4 T and has used a novel thermometer, ^{60}Co in Au, which is a Kondo system where the ^{60}Co sees about 40% of the applied residual field of 0.2 T. Eska reported reaching 0.7 mK with his $PrNi_5$ coolant.

Eska also discussed the technique of radiative detection of Nuclear Magnetic Resonance of Oriented Nuclei (NMR/ON). Eska and a colleagu illustrated the problems of the resonance technique by ending the session on a Bavarian note with a violin and flute duet!

Dr. W.A. Steyert (Los Alamos Scientific Laboratory) discussed the

state-of-the-art in dilution refrigeration and electric quadrupole orientation in metals. He discussed the ^{4}He circulating dilution refrigerator being developed by R. de Bruyn Ouboter at Leiden, the multiple-mixing-chamber ^{3}He dilution refrigerator being developed by A. Th. A. M. de Waele at Eindhoven University of Technology and the sintered-silver continuous heat exchangers developed by G. Frossati and D. Thoulouse at the CNRS laboratory in Grenoble. (These last two developments were discussed in ESN 30-7:328). But more important to NO studies is the top-loading ^{3}He dilution refrigerator first developed by B.S. Neganov at Dubna, USSR. This device allows investigations involving radioactive nuclei with lifetimes as short as a few hours. In fact, several sessions later M. Finger (Charles University, Prague) took a few minutes to describe the facilities at Dubna for NO investigations. He is part of an international team including D. Hamilton (University of Sussex, UK) and Neganov working on several NO projects. Presently they are using the off-line irradiation facilities at Dubna to study the nuclear properties of the Tb isotopes with Neganov's refrigerator. This refrigerator allows radioactive samples to be changed in ten minutes and to refrigerate them to 14 mK in less than three and a half hours. The next phase at Dubna is to provide an on-line irradiation facility.

W.D. Brewer (Freie Universität, Berlin) reviewed the Brute Force Orientation (BFO) technique in which the nuclei are oriented by the Zeeman splitting by bringing the nuclear spin system into thermal equilibrium in a large applied magnetic field. For most nuclei a value of 500 Tesla/K for the pertinent experimental parameter, H/T, is adequate for about 10% polarization. This is about the minimum useful polarization for NO experiments. State-of-the-art H/T is about 1000 Tesla/K. However, very few of the BFO experiments seem to produce as much orientation as expected from the magnetic moments obtained by other means such as NMR. Brewer reviewed critically the twenty-some BFO measurements made to date and what he believes is the reason for the lack of orientation.

L. Vanneste (Katholicke Universiteit, Leuven, Belgium) reviewed the technique of ion-separator implantation and nuclear-decay scheme studies. He showed that if the Hume-Rothery rules obtain, the implant into iron is nearly always good. The Hume-Rothery limits are; atomic radius between 1.10 and 1.50 Å and electronegativity between 1.30 and 2.10. In the discussion Hamilton showed that the Hume-Rothery rule also seems to work for the rare earths implanted in gadolinium.

Professor I. Berkes (University of Lyon, France) reviewed the technique of recoil implantation and contrasted its characteristics with ion implantation. In recoil implantation the primary ion beam is stopped in a target and the recoiling ions are implanted in the sample foil immediately behind the target. The energy distribution of the recoiling particles is nearly flat leading to a flat depth profile of implanted ions up to some maximum distance. The flux of implanted ions is about 1000-fold greater for the recoil technique than for the conventional ion implantation, and the damage near the implanted ion is less, but there will be more damage far from the implant due to recoiling α-particles.

The sixth session was chaired by Professor B.G. Turrell (University of British Columbia) who reviewed NO of antiferromagnetic structures. Most work has been on $MnCl_2.4H_2O$ and $CoCl_2.4H_2O$ and is consistent with the spin-flop concept.

H. Postma (Gröningen) gave a comprehensive review of the facilities available in the world for NO investigation with polarized and unpolarized neutrons.

Hamilton chaired the session involved with fundamental tests of symmetry violations. He reviewed the possible experiments to test parity and time reversal violations. During the discussion a description of the Cal Tech apparatus which cools a 1-2 mCi ^{57}Fe source to 17 mK was given by N.K. Cheung. The session closed with Steyert reminding the group that only one of the dozen isotopes studied for time reversal shows a violation outside statistical error and that about the same is true for the parity violation experiments. Hamilton and Postma are setting up a facility for polarized neutron scattering from oriented nuclei at Institut Laue-Langevin at Grenoble and would welcome active collaborators by next year.

The final day's discussion began with a review of NO in Kondo and spin glass systems by J. Flouquet (Laboratoire de Physique de Solides, Orsay). After reviewing the physics of the Kondo Effect, Flouquet argued that the NO technique has the following advantages

over other techniques: experimental simplicity, allowing the study of the hyperfine field of a specific nucleus at very low concentrations, and because higher energy γ-rays can be used than in the Mössbauer technique, the method is nearly universal. However, as he described the results of experiments, especially on the spin glasses, it became clear that a major disadvantage is the fact that NO is an integral method; it measures an averaged hyperfine field and is incapable of determining whether or not the hyperfine field is distributed or sharply defined at the nuclei. In the discussion Brewer argued that perhaps 50% of all NO data is useless because of impurity interaction effects and that more care should be taken in specimen preparation.

P.D. Johnston discussed the work done at Oxford on relaxation effects by NMR/ON. He reviewed the experiments on ^{60}CoFe and the effects of the electric quadrupolar field, especially on a single adiabatic sweep of the radio-frequency. Because of the level mixing, the anisotropy is not reversible. Much the same complications exist for ^{197}AuFe where the spin-orbit coupling gives rise to a stepping of the quantum number during the adiabatic passage.

The final session of this study meeting was chaired by G.V.H. Wilson (University of New South Wales, Australia) who had the task of innervating the participants to do some crystal ball gazing. I. Campbell (Physique des Solides, Orsay) gave a rather negative critique of NO from the theoretical point of view. He admitted that over the last decade the technology has made enormous strides but the results of the investigations are not yet ten times more significant. He did not mention the nuclear properties and felt the metals and magnetism are of primary interest to the theorists. Nevertheless, the Kondo problem, the last problem in this area to attract much theoretical discussion, is now a dozen years old. Theoreticians are presently interested in superfluid ^{3}He and phase transitions, and NO is not the most sensitive technique to investigate these phenomena. Unless something suggests that the RKKY (Ruderman, Kittel, Kasuya and Yoshida) interaction and well-known anisotropic effects do not explain the spin glasses, the difficult problem they present will not initiate a major theoretical effort. The remainder of the session was devoted to various enigmas that are of current concern. For example, Brewer discussed the problems of β-detection by detectors below 4 K.

Finally Stone, following the suggestion of several of the participants, discussed the circulation of research results on NO. He agreed to maintain a list of NO publications at Oxford if each researcher will let him know of any new work. This list will be made available to each laboratory on request--not just to the participants of this Conference. And thus ended a very useful NO study conference with no mention of Dr. No.
(T.A. Kitchens)

SHORT WAVELENGTH LASERS AT AMSTERDAM'S QUANTUM ELECTRONICS CONFERENCE

Several interesting advances in short wavelength lasers were reported at the Ninth International Quantum Electronics Conference held in Amsterdam, 14-18 June 1976. Two research approaches are being followed in the general area of producing coherent light sources in the vacuum-uv and soft x-ray spectral regions. They are plasma amplifiers operating on inverted ionic-level populations with limited coherence in a single-pass system, and highly coherent beams transferred from longer wavelengths by nonlinear mixing processes. It is anticipated that in the future the two approaches will eventually be combined to produce high power and coherence at very short wavelengths. However, current research is concentrating on each method separately and avoiding the vacuum coupling problems for the present.

In reaching wavelengths shorter than 1000 Å by nonlinear processes, the anticipated tripling of 1710-Å Xe-laser emission in argon to 570 Å by M.H.R. Hutchinson, C. C. Ling, and D. J. Bradley (Imperial College, London) reported in a postdeadline paper was well-deserving of the attention and credit received. In a visit to their laboratory following the Conference, we were told that they intend to quadruple ruby emission and couple this with the xenon amplifier to produce a short pulse near 1700 Å (since the xenon laser cannot be readily mode-locked), evidently for achieving higher power in the 570-Å beam which

would be useful for further mixing. They also are planning a next-generation xenon diode laser using a new electron-beam device called "Lark," designed specially by Charles Martin (AWRE, Aldermaston). Some parameters are 750 kV, 120 ohms, II kA, 20 nsec with a repetition rate of 10 pps. The accelerator is complete and the xenon chamber is being assembled.

In the area of direct amplification at short wavelengths the recent progress in achieving population inversions of R. J. Dewhurst, D. Jacoby, G. J. Pert and S. A. Ramsden (Univ. of Hull, UK) deserves noting. They have irradiated 5-μm-dia. carbon fibers with a 100-psec laser pulse of 150-mJ energy, preceded by a 10-mJ pre-pulse of the same duration. The resulting plasma is uniformly heated by rapid thermal conduction, and the expansion (observed to be uniform in all directions by measurements of escaping ions) is well described by a computer model. The credibility of the numerical code is enhanced by comparing observed and predicted space-resolved spectral-line intensities. By averaging the measured emission over 30 shots from Lyman-α and -β lines from hydrogenic C^{5+} ions formed in recombination, they deduce a population inversion between n=3 and n=2 levels. The measurements are in agreement with the numerical code which predicts an ionic inversion density on the order of 10^{16} cm^{-3} at an electron density of 10^{19} cm^{-3}; i.e., slightly less than 1% as would be expected. Since they have absolute intensity data, they can presumably deduce such numbers directly, with some deconvolution for Lyman-α capacity. This is a step forward towards lasing near 180 Å, since it implies significantly higher inversion densities than previously reported in *J. Phys.* B7, 1109 (1974) by F. E. Irons and N. J. Peacock (less than 10^{12} cm^{-3}) at Culham Laboratory, Abingdon, Oxfordshire. Ramsden is hoping to extend these measurements to achieve a net gain with a larger two-beam 20-J, 100-psec laser system.

M.H. Key and collaborators (Queen's University, Belfast) have been looking for evidence of population inversion on the same transition in the same ionic species as the Hull group in a rapidly expanding plasma formed at the linear focus of a 3-J, 100-ps Nd laser on a carbon slab target. Their most recent measurements were reported in a paper at Amsterdam, and further details were obtained in a visit following the Conference. Some "very preliminary" time- and space-resolved single-shot spectral measurements of the 3→1 and 2→1 lines in carbon VI (28 Å and 33 Å) made with a grazing incidence spectral dispersion system and a highly sensitive vacuum-uv high-speed streak camera showed a population inversion on the Balmer-α line. A rough absolute intensity calibration of the spectral dispersion system allows them to estimate an inversion density sufficient to achieve a laser gain coefficient of ∿0.5 cm^{-1}.

Recent progress in the investigation of lasing on the 117.41 Å line in Al^{3+} was discussed during a visit to Pierre Jaegle and colleagues at the University of Paris, Orsay. This line involves a transition from the $2p^5\ 4d\ ^3P_1$ level of the neon-like ion into the $2p^6\ ^1S_0$ ground state. Their latest theoretical interpretation of the process producing the inversion involves dielectronic capture and collisional transfer stabilization favoring the upper laser level. The experimental setup involves the creation of two adjacent plasmas 1.8 mm apart, the first of which acts as a source of 117.41-Å line radiation, while the second plasma acts as an absorber or amplifier. The adjacent plasmas are created with a single 20-J, 35-nsec Nd-laser pulse using a split spherical lens. The laser, which is Q-switched by a rotating mirror, and the focusing system cause the creation of the source plasma about 10 to 15 nsec sooner than the amplifying plasma, but the 35-nsec lifetime of each plasma provides considerable overlap in time. The most recent observation is that the gain occurs during the heating phase of the amplifying plasma, and some theory is currently under development to understand this effect. The shot-to-shot statistical variation of the observed time-resolved line intensity is large and is partially attributable to non-reproducibility of the target position; this problem will be remedied soon by the installation of a better mechanical target mount. The most recent measurements show a peak negative absorption of ∿ 32%.

Another paper of interest in the field of frequency-mixing in gaseous media involved third-harmonic generation in a Rb-Xe mixture by H. Puell and C.R. Vidal (Max Planck Institute for Extraterrestrial Physics, Garching, W. Germany). This study represents the first quantitative investigation into the limiting mechanisms of third-harmonic generation in vapor systems. Using 7-psec duration pulses from a mode-locked Nd glass laser, the authors

observed deviation from cubic dependence of harmonic power on pump power at a pumping level of 10^{10} W/cm^2. The deviation which occurred at a conversion level of about 1% was well accounted for in theory by including effects of phase mismatches due to the nonlinear Kerr effect and also fifth order terms. At still higher incident intensities conversion was again seen to increase, as the Kerr effect saturated. Maximum conversion of the order of 20% is predicted by the authors by choosing a κ vector offset at low intensities such that optimum phase matching occurs near the peak of the pulse. The authors also noted asymmetries present in the phase matching curves as a function of buffer gas pressure. Such asymmetries are associated with the transition zone in the heat pipe and provide a technique of studying the extent of such zones.

In a subsequent visit to Vidal's laboratory in Garching we learned that he is planning to apply vuv sources to high-resolution spectroscopy of molecules of interest in extraterrestrial physics, using a 10-m vuv grating spectrometer. As a prototype study he is determining parameters associated with the potential curves of Mg dimers for which a good many atomic parameters are well known. He feels this study can provide insight into the reaction kinetics of the rare gas-halide excimer lasers which form excited states similar to those of Mg.
(R.C. Elton, L.J. Palumbo, and J.F. Reintjes, Naval Research Laboratory)

THE PHYSICS OF NORMAL METAL CONTACTS

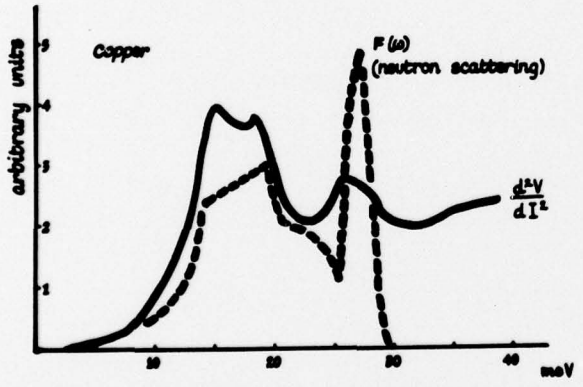
An interesting thing happened on the way to the Solid-Vacuum Interface meeting in Eindhoven (which I will report subsequently). I stopped by the Katholicke Universiteit in Nijmegen to visit Herr Professor F.M. Mueller who has recently become the doyen of Nijmegen's new Computational Physics group. H.W. Myron has come from Northwestern University to work with Mueller, and they will maintain their interests in electrons, phonons, and transport properties. Thus, despite the wider mandate suggested by the name of the group, they will interact most strongly with the three solid-state professorships which represent nearly 100 scientists at Nijmegen. In between the usual painful experiences of establishing remote terminals to various computer systems (those at Amsterdam and Gröningen) these interactions have already borne fruit, and I will describe that here. Mueller presented most of this work at the Second Rochester Conference on Superconductivity in May, so if you attended you may stop reading now.

Professor P. Wyder, one of the Solid State Physics professors at Nijmegen, the chairman of the "Stichting voor Fundamenteel Onderzoek der Materie" (FOM)--the Dutch National Materials Research Organization--director of Nijmegen's Research Institute for Materials and a member of the University's board, somehow found time to notice one of the very last papers presented at the International Low Temperature Physics Conference at Helsinki last summer. This was a paper by I.K. Yanson (Physio-Technical Institute of Low Temperatures of the Academy for the Ukraine, Kharkov, USSR) on nonlinear effects of the electrical conductivity of normal metal contacts. This paper was novel in several respects. It reported a study of the I-V characteristics of point contacts where both electrodes are of the same and furthermore normal metal. Most studies of this type involve at least one superconducting electrode where the sharp electronic density of states is used as a probe. And the point contact was established in an unusual manner--by electrical breakdown at liquid helium temperatures of the thin (less than 100 Å) insulating layer between the two thick films of the normal metal.

Based on theoretical work by Yu. V. Sharvin (Zh.E.T.F. 48, 984 (1965) and with N.I. Bogatina (Zh. E.T.F. 56, 772 (1969)), Yanson argued that, for his high-resistance contacts, the metallic lattice and conducting electrons experience no thermal heating effects and that a particular derivative of the I-V characteristic of the point contact, $d(dV/dI)/dI$, is the electron-phonon interaction function, $g(\delta)$, smeared by inelastic tunnelling effects at the thermal bath temperature. In fact, Sharvin's work gives $g(\delta)$ as the product of the square of the averaged electron-phonon scattering matrix element, $\alpha^2(\delta)$, and the phonon spectral density function, $F(\delta)$--much the same information one obtains in normal-superconducting tunneling.

[For example see W.L. McMillan and J.M. Rowell, *Phys. Rev. Lett.* 14, 108 (1965).] Yanson presented $g(\omega)$ for In and Cu and has also worked on Al, Ag, Pb and Sn contacts. While these $g(\omega)$ have the characteristic peaks associated with the transverse acoustic (TA) and longitudinal acoustic (LA) phonons in $F(\omega)$, the results suggest that $\alpha^2(\omega)$ in Cu decreases as ω increases toward the LA phonons.

Wyder, Mueller and a new student, A.G.M. Janson, repeated the Cu and Ag experiments and have also measured Au within the last few months. The I-V characteristics are symmetric, suggestive of pure resistive phenomena. The resulting data, which agree qualitatively with Yanson's data in the case of Cu, have peaks characteristic of the bulk TA and LA phonons except that the higher lying (LA) peak is relatively much smaller than would be expected from the $F(\omega)$ from inelastic neutron scattering as seen in the figure below:



Mueller interprets this as evidence that the bulk phonons are playing the significant role in these contacts but that $\alpha^2(\omega)$ varies due to the strong d-electron character of the noble metals. Some of the details of this argument for strong energy dependence of $\alpha^2(\omega)$, which is quite important to understanding the superconductivity of d-band metals, is given by a student of Mueller's, S.G. Das [see *Phys. Rev.* B7, 2238 (1973)]. And from the detailed arguments, it is clear that a study of the magnetotransport properties will be very valuable in understanding the mechanisms at work here. Clearly Nijmegen will be in a very strong position to make such studies since the hybrid magnet (capable of about 25-Tesla, which will be a new record for a DC field) built by the National Magnet Laboratory, MIT, should soon be delivered.

But I have not yet mentioned the unusual and beautiful simplicity of these contact experiments as they are done at Nijmegen. In the case of copper the material used was just commercial copper wire directly off the workshop spool. One electrode was sharpened into a "spear" with a point of about one-half micron radius. This was carefully jabbed toward a stationary piece, called the "anvil," with a differential screw mechanism, and the final adjustment, with a resolution of one-one hundredth of a micron, was made with a piezoelectric lever arrangement. Such simplicity can only be regarded as elegant! For only a few guilders the Nijmegen group has sounded the tocsin for a new way to study the electron-phonon interaction so important to superconductivity and other *low temperature properties of metals.* (T.A. Kitchens)

NEWS & NOTES

NUMERICAL ANALYSIS APPOINTMENTS AT CAMBRIDGE The University of Cambridge has initiated a new program in numerical analysis and scientific computing. Effective 1 August, Mr. M.J.D. Powell, formerly of the Atomic Energy Research Establishment at Harwell, became the first appointee to the newly created John Humphrey Plummer Chair of Applied Numerical Analysis.

Professor Powell, who is best known for his many contributions to optimization theory and the development of computational algorithms for nonlinear optimization, will be associated with the Department of Applied Mathematics and Theoretical Physics. In addition to carrying on his own research, he will develop numerical analysis supplements to both the undergraduate and graduate curricula.

In conjunction with Mr. Powell's appointment, the Governing Body of King's College, Cambridge, is inviting applications for positions of Senior Research Fellow in Numerical Analysis. Successful applicants will undertake

the research of their choice and will have access to an IBM 370/165 computer through the Cambridge University Computing Service. Applications should reach the Provost by 1 October 1976 and be accompanied by a statement of the applicant's date of birth, academic career, qualifications and the names of not more than three references. The applicant should also indicate his or her research interests and describe the research which would be undertaken if elected to a Fellowship.

The selection of Fellows will be in December 1976, and the date of commencement will be 1 October 1977 or such other date as is mutually convenient to the candidate and the College. The term of appointment may be as long as four years. The stipend which depends upon the Fellow's age and marital status, may be supplemented by undergraduate teaching.

Candidates may submit their application to the Provost through the office of Prof. Powell (Dept. of Applied Mathematics and Theoretical Physics, University of Cambridge, Silver Street, Cambridge 3CB 9EW, England).

PERSONAL

Professor Francis Aylward, Head of Food Science, University of Reading, will retire in September. His successor will be Dr. H. E. Nursten, at present in the Department of Food and Leather Science, University of Leeds.

ONRL REPORTS

R-6-76

PTARMIGAN: A UK SECURE AREA-COMMUNICATION SYSTEM FOR ARMED FORCES by D. K. Cheng

This report summarizes the technical and operational characteristics of the PTARMIGAN system, a UK-developed secure area-communication system for armed forces. It is a computer-based, automatically switched and mobile system that will provide voice, telegraph, data and facsimile modes of operation over a wide geographical area.

R-7-76

AN INDUSTRIAL TECHNOLOGY CALLED TRIBOLOGY--THE UK EXPERIENCE AND ITS IMPLICATIONS by R. H. Nunn and H. Herman

Tribology, defined as the science and technology of interacting surfaces in relative motion and of related subjects and practices, is the result of a series of UK activities, begun in 1966, to provide remedies to certain industrial ills. This report, intended for the general reader, is an overview of the birth, growth, and present state of tribology in the UK. The actions of the Committee on Tribology are discussed, as well as those of the Tribology Centres and other UK organizations concerned with lubrication and wear. Relevant but broader issues are also discussed. These include the interdisciplinary approach, effective communication between academia and industry, and the concept of industrial technologies. Comments are offered concerning the lessons to be learned from the UK experience. Appendices provide brief descriptions of the proposed education module in tribology, the symposium titled "Tribology 1976," and the practice of lubrication analysis including ferrography.

C-20-76

MONITORING BEHAVIOR AND SUPERVISORY CONTROL by J. W. Miller

This was a five-day NATO sponsored symposium which had as its objective the convening of scientists and engineers involved with the complex man-machine relationships in controlling vehicles and large scale processes. Thirty-eight presentations were given covering the general topics of man-vehicle control, general models and process control. Much attention was given to the changing role of man from controller to system supervisor; to the impact of this change on training, selection, mathematical modeling of complex systems and human performance; and to the measurement of operator workload. Presentations included descriptions of newly developed models, individual display and control systems, and the interaction of man and his computer "slave." Proceedings of the symposium will be published.

C-21-76

1976 INTERNATIONAL ZURICH SEMINAR ON DIGITAL COMMUNICATIONS by LCDR D. C. Rummler

This report reviews selected papers presented at the 1976 International Zurich Seminar on Digital Communications which have potential application to military communication systems. The papers reviewed cover the areas of LST technology in digital communications, high speed transmission

C-21-76 (cont'd)

systems, high-frequency channel error detection and correction, integrated picture-display and voice communication systems, architecture and design of a multiple-microprocessor network, error-detection and system reconfiguration in distributed signal processing systems and data network ciphering.

C-24-76

NUCLEAR ORIENTATION STUDY by T. A. Kitchens

In mid July 1976, a European Study Conference on Low Temperature Nuclear Orientation was held in Oxford. The Conference concentrated on techniques and brief summaries of the state-of-the-art. The techniques covered were adiabatic demagnetization, dilution refrigeration, brute force orientation, ion implantation, recoil implantation, γ-ray anisotropy and radiative detection of nuclear magnetic resonance of oriented nuclei. The understanding gained by these techniques of the nuclear decay schemes, nuclear dipole and quadrupole moments, nuclear level assignments, parity and time-reversal violations, metallurgy, magnetic order, relaxational effects, and the Kondo and spin glass phenomena was reviewed.

C-25-76

THE ISRAELI-AMERICAN INTERNATIONAL CONFERENCE ON APPLIED METALLURGY by H. Herman

This joint ASM-IMS meeting on applied metallurgy was attended by a good representation of academia and industrial scientists and engineers. A wide range of topics was covered; from non-destructive evaluation, joining, failure analysis, to electronic materials. The diversity and sophistication of interests shown by the Israeli indicated that theirs is a growing and forward-thinking industry, and that joint international conferences like this one are in fact mutually beneficial.